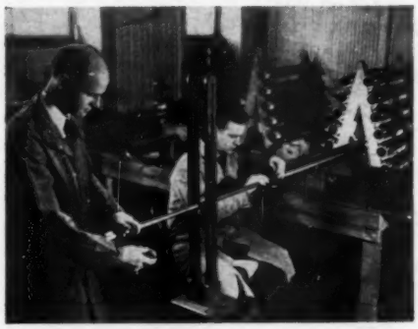
TECHNOLOGY DEPT.

# AMERICAN MACHINIST

*April 16,* 1941



**Star Gaging**—*Not to be taken as a method for gaging stars, this means of gun bore inspection is so named because of three points which contact the bore*

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# For the production man called to the defense of a nation . . . . .

★ The Defense Program has called thousands of new workers into the Metal-Working Industry and has brought new problems and responsibilities to the hundreds of production men whose plants are changing over to defense orders. If you have recently been called into a new job on the production of defense items—or if your plant is now working on a government order—you will find *American Machinist* full of timely information—as always. Here is the way one subscriber puts it:

**A. A. STEARNS**
*Former Chief Inspector, Superior Engine Div., National Supply Co.*
*Now on defense production with Baldwin Locomotive Works*

*"Just a line to say that I approve of your program for articles in coming issues of American Machinist, and I shall read them with interest. Your article on gun-tube machining in a Canadian shop in a recent issue was particularly interesting to me, since I am at present in this line of work."*

# WHAT'S IN THIS ISSUE

**GOING, GOING . . .**

In case you were at the tool show in Detroit last month, you probably remember booth No. 176, with its Packard marine engine and longitudinally split shell cases. Booth No. 176 was AMERICAN MACHINIST'S, and one of its attractions which vied strongly with the shell and engine for visitors' attention was a 124-page book on shell making. Entitled "Artillery Shell Manufacture," this 8¾x11½-in. book consists of reprints of all our recent Armament Section articles on tooling set-ups for high explosive shell, along with some previous articles on machining 75-mm. shell, forging 3.7-in. shell, and making artillery cartridge cases. Included is an index to every operation and piece of equipment mentioned. The whole thing is attractively bound in a heavy cover intended to withstand lots of abuse. Although only briefly hinted at in these columns last issue, these books were well received when introduced at the show. We were mighty pleased, though hardly surprised, at the enthusiastic comments from fellow exhibitors who had a chance to look them over carefully. They're still going, fast, so if you want any copies, better order early. They can be mailed anywhere in the United States or Canada. The price is one dollar each, eighty cents each in lots of ten or more. Write to AMERICAN MACHINIST, 330 West 42nd Street, New York City.

**MORE ON MUNITIONS**

As munitions making goes, trench mortars don't present the world's worst manufacturing problems. In fact, any reasonably well equipped shop could expect to turn out these small devices without too much trouble. But, as E. H. Fisher points out, some of the innocent-looking parts have rather close tolerances, and equipment for their production must be in first-class condition. Mr. Fisher is works manager of A. B. Farquhar, a company which has developed many simple but efficient tooling set-ups to help in making mortar parts. In this issue's Armament Section, beginning on page 341, he describes the more important operations, the set-ups employed, and the reasons for using them.

**BRIGHT**

Raymond F. Yates' letterhead is impressive. "Former managing editor Popular Science Monthly, editor Popular Radio, Television, Everyday Mechanics, chief engineer Hudson Engineering Corp., Electrad Corp. of America. Now patent editor of Mechanics and Handicraft, formerly editor of Modern Mechanics and Inventions, author . . . " On and on it goes, but you get the idea. If Mr. Yates' background doesn't equip him to give you the lowdown on the latest in hard chrome, we give up. Anyway, he's compiled a series of articles on the subject, the first of which you'll discover simply by turning the page. It discusses various bright ways in which this bright metal has been found to lengthen tool and die life—in some cases amazingly.

**IN BALANCE**

To any lover of machinery, nothing is sweeter than the low hum of smoothly running equipment, nothing sourer than the racking vibration of some poorly balanced job. Time was when rotating machinery was balanced mostly by guess; the mass of shallow holes hopefully drilled into old flywheel rims testifies to a hazy understanding of dynamic balance. Nowadays, a rotating part can be spun in a machine, dials read, lead rivets applied, and the part's balanced. Straightforward engineering underlies all balancing machines, and the basic principles can be applied without highly specialized equipment. These are the principles which F. C. Rushing, of the Westinghouse Research Laboratories, discusses in his article beginning on page 334. We recommend it to anyone who even goes near rotating machinery.

F. C. RUSHING
*. . . it's better, balanced*

**NATURAL**

Fear of fire is as natural, as old, as life itself. Well might it be. Only one who has stood by helpless while his home or business has roared up in smoke can testify to the terror, the rage, the defeat that wells up in his heart. Little wonder is it that as a morale- and property-destroyer, fire ranks as warring nations' most potent weapon. Just set it going, then enjoy the spectacle of a ship, warehouse or plant consuming itself. For the saboteur, fire is truly a natural. An overloaded electric motor, a quench tank which occasionally blazes up—these could start disastrous fires which might or might not be accidental. For smothering such fires while they're still mere flickers, carbon dioxide gas is ideal. On page 331 V. J. Hill, vice-president of Walter Kidde & Company, outlines practical applications of this gas in guarding against some typical machine shop fire hazards.

**ROTARY**

Though there's nothing startlingly new in the idea of a rotating table carrying work to successive stations, we feel you'll be interested in the application described on page 332. In it massive welding fixtures are brought to a single operator who otherwise would be climbing over and around and through them like a trapeze artist. It helps save space, too, and solves a few other problems that crop up when you put a lone welder down in the midst of a general manufacturing area. The installation is in the John Deere Wagon Works; the description is by J. B. Morgenthall, chief tool designer.

## COMING

In line with the current sabotage scares, you'll be interested in an article scheduled to lead off the contents of the next issue, dealing with various uses of lighting to prevent sabotage. Surely in these days nobody needs to be reminded twice of the old wheeze about an ounce of prevention. Also on tap is a further discussion of carbide tools for turning, another installment in the hard chrome series, and details of some low-cost high-production dies. The Armament Section will return its attention to aircraft, with an analysis of tooling methods used in fuselage production. Keep your eye peeled for the April 30 AMERICAN MACHINIST!

# A MACHINE TOOL FOR SHEARING METAL

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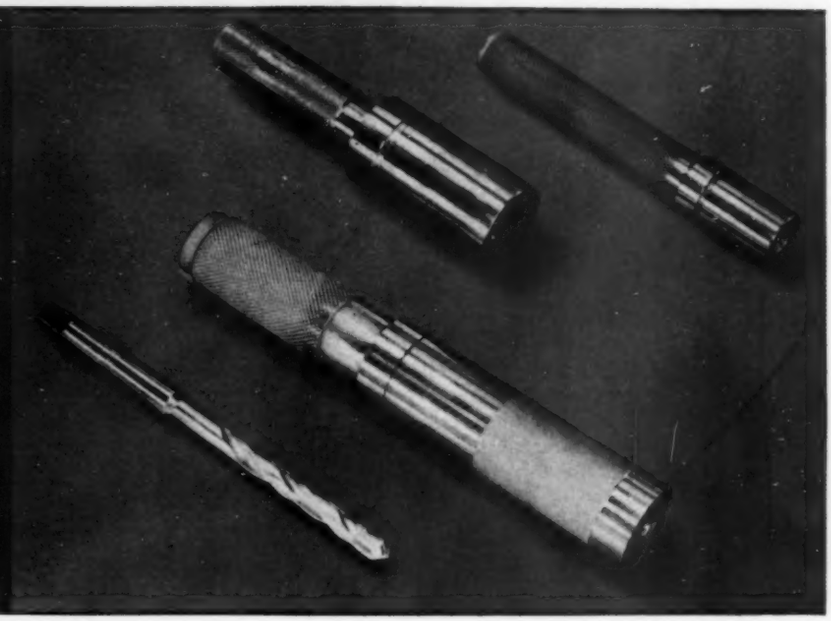
HARD CHROME FOR TOUGHER TOOLS — No. 1



# Plating for Life—Not Looks

BY RAYMOND F. YATES

**Flashy appearance has nothing to do with this application of chromium plating. But hard chrome can be spectacular in extending the life of many tools**

CHROMIUM is a metal of many merits. Aside from its obvious glitter, it has a dense structure, a high melting point and excellent resistance to most forms of corrosion. In addition, it is extremely hard—in the electrodeposited form its hardness approaches closely that of the diamond, although it may be obscured by relative softness of the base metal.

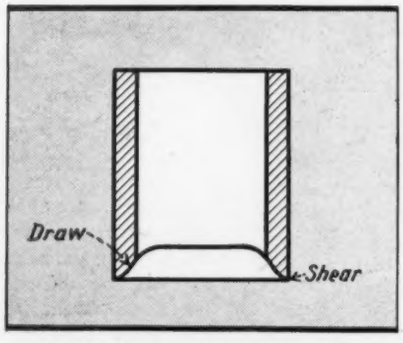
As to hard—as distinguished from decorative—chromium, if Dr. D. A. Cotton, in charge of research at Delco-Remy, was not actually the first in this field, he was certainly among the earliest arrivals, having initiated his experiments in 1928. A small chromium plating tank was placed in the toolroom at that time and it has never been removed. With this 50-gal. tank, Dr. Cotton and his associates not only contributed much to knowledge of hard chrome plating, but they also made substantial contributions to the net earnings of their company. Although it is known that the installation saves at least $15,000 annually by contributing to the life of tools and gages, the added productivity given to certain machines has never been translated into dollars. It is known only to be large.

Most of the early work done with hard chrome involved plug gages which had worn undersize. The procedure was simple enough. Whereas chromium plated over steel for decorative purposes must be deposited over an intervening layer of nickel, in the case of hard chrome the nickel is not necessary. The metal was just carefully cleaned and placed in the bath. In the case of simple articles with plane surfaces and no deep depressions, the plating operation was carried on normally, with no need for special racks or fixtures. Undersize gages were simply plated until they were oversize. They were then removed from the bath and ground down to the proper dimensions. Since the treatment could be repeated many times, certain gages remained in use many years. The saving each time a gage was replated amounted to the difference between the cost of a new gage and the cost of the plating job—which was very small, perhaps less than a dollar in many instances. If used only for resurfacing gages, a small chromium tank would save many thousands of dollars in some plants. But hard chrome has many extensions and ramifications.

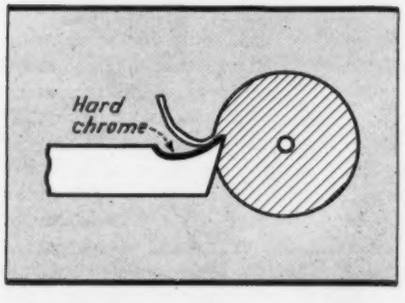
In plating plug gages and similar small circular parts which are to be ground, rotation in the solution to insure uniform deposit thickness is unnecessary. If there is any out-of-roundness, grinding will remove the excess metal. Tools which can easily be reclaimed by hard chrome plating include broaches, taps, burnishing tools, reamers, spot facers, spinning tools, drill jigs, hobs for brass, files, rolls,

chuck heads, cams, drawing dies, coining dies, header dies and molds for plastics, rubber, etc. Experience has shown than at least one hundred applications can be made in the average factory engaged in the fabrication of metal. These relate to the salvage of worn parts, the preservation of accuracy, the reduction of wear and the increase of cutting efficiency.

As an example of prolonging both cutting efficiency and life of certain tools, the case of the common file may be cited. Whereas the term "hard chrome" usually refers to a deposit of the metal of 0.0005 in. or more, a much lighter application often produces extraordinary results. When files intended for use in shaping hard steels of the chrome-vanadium types are treated briefly in the chromium tank, they will outlast an untreated file by 300 to 400 percent. An unplated file, when used on material of this sort, is soon worn smooth and reduced to a state of uselessness. On the other hand, a brief exposure to chromium lasting not more than two minutes and perhaps not costing more than several cents a file is, in reality, equivalent to the price of from three to four files. This is quite apart from the faster cutting possible.




*Only 0.0005 in. of chromium applied to the drawing area of this die boosted its production from 5,000 to 20,000 parts*




*Hard chrome plated onto the top surface of some lathe tools provides faster cutting and easier chip removal. Limited deposition is secured with stopping-off lacquers*

*This 100-gal. lead-lined tank, heated by ordinary gas, is sufficient for most toolrooms. Plating heavy drills improves performance on plastics*

As often repeated, the machinist has always had a multitude of taking-off tools, but never a putting-on tool—until the appearance of hard chrome. There are many instances where such an apparent luxury would save a great deal of money. In one case work had almost been completed on a $5,000 series of molds when word came from the engineering department of a small but extremely important change in measurement; something calling for the replacement of metal which, under ordinary conditions, would have been considered impossible. It so happened that the metal, in the form of chromium, could be applied electrochemically at a cost of $200. Here $4,800 worth of labor and materials were saved within a few hours. The number of productive hours gained was not estimated. Even in the face of this saving, the cost was high because the job called for the covering of 2.15 sq.in. of steel surface with a layer of chrome 0.024 in. thick. In many instances, where it is not necessary to construct elaborate plating racks and fixtures, the cost of current at approximately 100 amp. per sq.ft. is the major item of expense.

The day is rapidly approaching when a chromium tank in the toolroom will be indispensable. This is especially true in plants which have a great deal of die and mold work. A short time ago, at Delco-Remy, it was found necessary to build up a hole inside a switch handle die. Twenty-four dies involving a large sum of money were affected, and although several thousandths of chromium had to be applied inside a square hole only $\frac{3}{16}$ in. across, the job was accomplished without difficulty.

Sketched is a die used in blanking and forming stainless steel ignition lock caps. During a period when the stock was not up to ordinary standards, a great deal of trouble was experienced with this tool, the metal showing an aggrevating tendency to tear on the radius. Failure of the die at the end of every 1500 operations was costly and annoying. However, when 0.0005 in. of chromium was applied to the drawing area of the die, 20,000 operations could be performed easily.

### Plating Improves Plastic Molds

A tank for chromium is a valuable adjunct for any manufacturer operating plastic molding machinery. Many plastics subject steel molds to severe abuse by etching. If this is permitted to continue without remedy, a point is finally reached where the articles molded suffer a loss of lustre. Normal practice is to remove the molds at specified intervals (as frequent as every day if the mold is used extensively) and to submit it to a light polishing operation. Even what is known as a "flash" of chromium, requiring only a few minutes, is sufficient to preserve the polish of a mold for as long as a month. Application of 0.001 in. of chromium will carry the ordinary mold through a lifetime of continuous use. It now is the practice in some toolmaking establishments to make new molds about 0.002 in. undersize, the proper dimensions

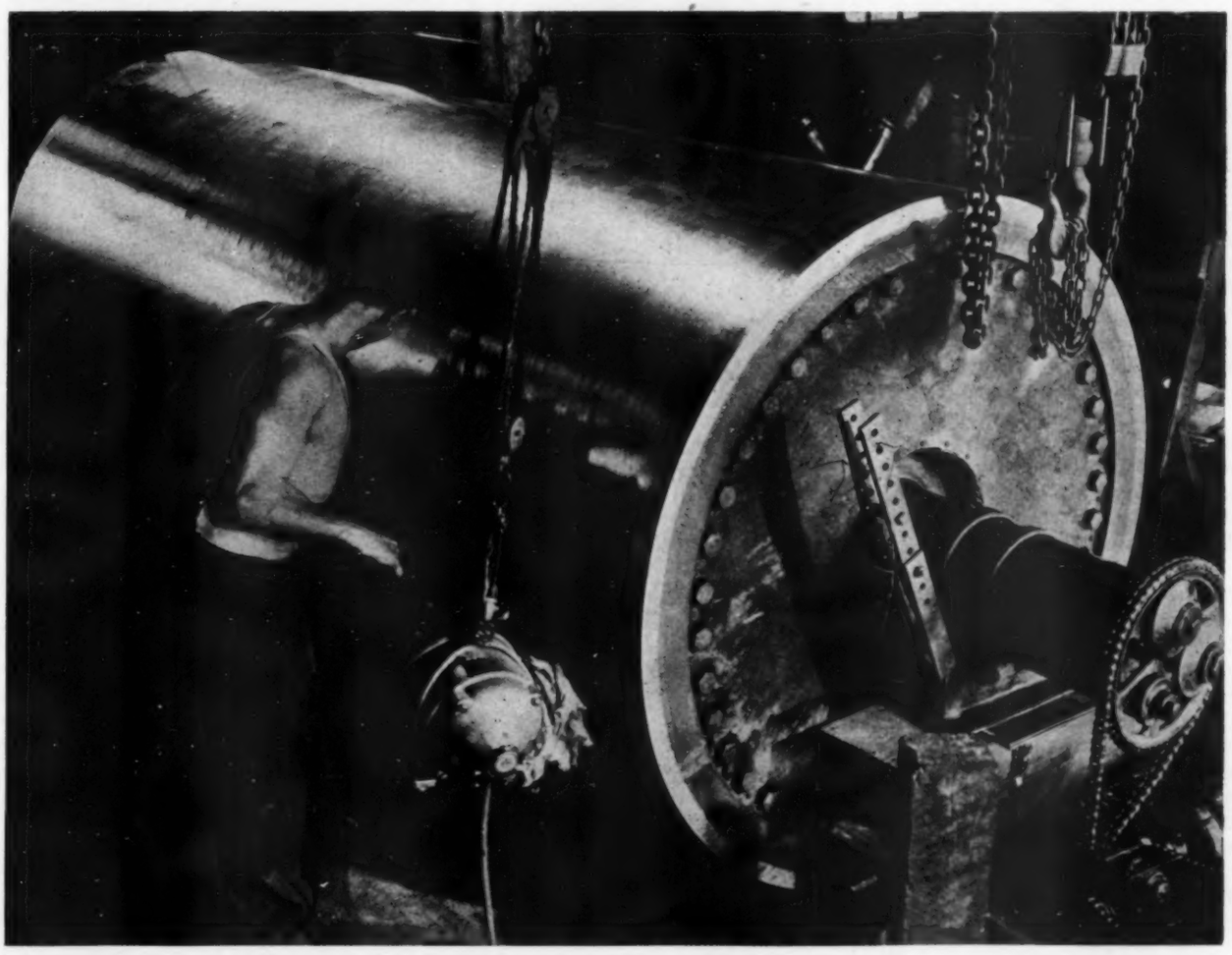
being supplied by the deposition of this amount of hard chrome.

Drills intended for use in work where tolerances permit can be plated with chromium, as little as 0.0001 in. providing marked results especially in drilling non-ferrous metal and plastics. When used in such work, drills so treated ordinarily last from five to eight times longer than untreated drills. Taps and dies, where tolerance permits, will provide longer and better service if they are plated before being put into service. Usually a deposit of only 0.0002 in. is sufficient to extend greatly the useful life of such tools.

Most plastic molding calls for hydraulic pressures of 2,000 to 6,000 lb. per sq.in. Rams of most presses vary between 8 and 14 in. in diameter. Called upon, as many such presses are, to operate for 8 to 16 hours daily in 3-min. cycles, it is to be expected that packing ring trouble is likewise large. Even daily 8-hr. use calls for repacking monthly. Here loss of the service of the machine may be more costly than the labor. The result of hard chrome applied to the ram of one press was that the ram was placed back in the press and everyone apparently forgot about the incident. Monthly inspection failed to reveal any trouble. Many months later one member of the technical staff happened to recall that it was the ram of this press that had been plated. For eight long years, this press did its daily chore without suffering interruption for packing. It was estimated that annual repacking costs formerly amounted to $144 per press, for those using 12-in. rams. It is common practice now to treat such rams with hard chromium. It costs approximately $50 to plate a ram of this size.

Often the chromium plating of draw dies not only adds many productive hours to service life but at the same time contributes substantially to a better product by reducing or actually eliminating score marks. Incidents have been cited where a few hours' treatment in the chromium tank so increased the efficiency of such dies as to eliminate a subsequent operation. The same results are obtained with spinning tools. There is a tendency to lessen tool marks and prevent tearing of the metal. Tool life is also extended.

Until a short time ago, most experts in this new field shared the belief that hard chrome could not be successfully applied to dies of the shear type. Here it was thought that impact pressures would be far too excessive. In the punching of armature laminations, as an example, such dies are usually operated until burring becomes heavy. A new set of punches could be run about 50,000 times before grinding became necessary. Subsequent grinding increased the output until a point was reached where operation would average 150,000 pieces between grinding treatments. Dr. Cotton experimented with chromium plating the punches on the flat ends, applying about 0.001 in. of the metal. Whereas new unplated punches would yield 50,000 stampings before resurfacing was necessary, plated punches produced as many as 391,520



*A paper-making steel roller is polished after being hard chrome plated. To prevent excessive current demand, the roller is slowly revolved over a trough of solution with only a fraction of its surface immersed. As much as 72 hr. may be required to build up the desired deposit*

pieces. In this work it has been found that both male and female die parts must be plated.

In a large number of cases, simple chromium plating requiring only an hour or so in the tank has brought sensational and even fantastic results. In fabricating horns, for instance, the ordinary operation of rolling the metal into a tube and passing it through a swaging die before welding was found unsatisfactory because of difficulty in the final welding operation. A coining die not only gave a better job but doubled the output. However, the coining die was a very uncertain element. Often, after only a few minutes of operation, it would gall and interrupt production. After these dies were chromium plated, they gave perfect service for weeks on end, one of them setting the record of 700,000 pieces. A change in design took it out of service at this point.

The fact that chromium has no affinity for solder makes it useful on soldering jigs. The operator is not interrupted by the constant necessity of cleaning up his jig and removing solder from vital parts. Duckbill pliers used for immersing small parts in solder baths may also be treated lightly with chromium to prevent adherence.

### Wear Drastically Reduced

A small difference in hardness may mean a tremendous difference in actual wear resistance and longer useful life. A steel plug gage showing about 87 scleroscope provided 9970 checks before it reached a point where tolerance was apt to be seriously violated. The same gage, after plating, read 95 and stood up in serviceable condition for 48,924 checks. Wear was 0.0002 in.

In inspecting mass production locks with test keys, it was found that ordinary steel keys lasted for only a few hours. Chrome-plated keys stood at least one month and were capable of 143,000 insertions.

In plants where hard chrome installations are in daily use, it is not uncommon to see a toolmaker in trouble furtively seeking the assistance of the electroplater. A bad week-end often means a Monday morning mishap of 0.001 in. undersize. In simple cases where no special plating fixture is required for deep throwing into recesses, a half hour or so in the tank will often correct an error and save both peace of mind and valuable labor.

Hard chrome plating of heavy steel rolls used in the paper making and other industries is already an established industry. Applications up to 0.016 in. are made with ease, and even though some of the larger jobs cost as much as $5,000 each, they are still economically sound. Certain it is that no other method of producing hardness on surfaces can begin to compare with the electro-deposition of chromium.

Chrome-plated steel articles are capable of taking a very fine finish by lapping and grinding, the resulting surface being far superior to that which can be produced on any quality or grade of steel regardless of its hardness. Such a chromium finish placed over steel test bars used in aligning crankshaft bearings added hundreds of useful hours to their life. Heat-treating of such bars invariably produced a degree of warping, whereas plating had no tendency to distort the metal. Indeed with steel gages of any kind it no longer behooves the designer to use only the hardest metal. In many instances, comparatively soft steels may be used provided they are encased with the proper thickness of chromium.

It would appear now that the future application of hard chrome is not in any sense going to be limited to steel. Certain applications are available to brass and copper. Aluminum, due to the wide success of the Krome Alume process, may also be plated with heavy deposits of chromium, and experiments are being made with chrome-covered dural machine parts to be used where heavy wear is involved. In small parts used in high-speed reciprocating motion, the lighter dural is strong enough but its surface does not wear well enough. A few thousands of chrome supplies this deficiency.

A number of engine manufacturers are also experimenting with hard chrome plated aluminum pistons. Producers of portable gas-electric plants now contemplate the early production of aluminum cylinders for such equipment. Tests show that they outlast steel.

*Briquet-making rollers treated with hard chrome plating last much longer than ordinary steel. They can be replated repeatedly*

# Afraid of Fire?

BY V. J. HILL, VICE-PRESIDENT, WALTER KIDDE & COMPANY

**Naturally. But if your special worry is electrical machinery or liquids, try carbon dioxide. It smothers flames efficiently and then floats away without a trace**

HOW DO FIRES start in machine shops? The National Fire Protection Association gives the following percentages: heat-treating, 10; oil burners, 8; cutting and welding, 8; spontaneous ignition, 7; sparks and friction, 6; hot materials or heat-igniting combustibles, 6; miscellaneous special hazards, 25; electrical, 15; and miscellaneous common causes, 15.

These hazards are chiefly of the types classified by the Underwriters' Laboratories as Class B (flammable liquids) and Class C (electrical equipment). These fires don't respond readily to water streams. They require special extinguishing methods.

Fires in wood, paper, shavings, and the like, are put out by quenching and cooling action. Water-type extinguishers do this best, under ordinary circumstances. But electrical fires and blazes in flammable liquids must be *smothered,* or blanketed. Moreover, the extinguishing agent for use on electrical fires must be a non-conductor to permit its use against fires in live equipment, without danger of shock to the operator. These requirements are met admirably by carbon dioxide gas.

Carbon dioxide smothers fires by taking away oxygen. When the normal 21 percent of oxygen in the atmosphere is reduced to 14 or 15 percent, ordinary combustibles will not burn. When you hit a blaze with the contents of a carbon dioxide portable extinguisher, you displace a large portion of the air around the blaze with this inert gas. When you discharge a built-in extinguishing system into an inclosed space, you create a gas-air mixture which kills fire throughout the entire room.

This smothering action happens so quickly that carbon dioxide is recognized as one of the fastest of all extinguishing agents. In the extinguisher the gas is compressed at 850 lb. per sq.in., and is discharged under its own pressure. As it emerges from the discharge nozzle it expands to 450 times its stored volume. This expansion gives it terrific penetrating power, an ability to spread throughout the fire area. It drives around obstructions which would block an ordinary liquid stream.

Where the fire hazard is not too intense—on workbenches, small electric motors, etc.—a portable extinguisher provides ample protection. There is another kind of hazard, however, which calls for a rapid mobilization of large volumes of the extinguishing agent, due to the concentration within a small space of combustible materials. This hazard may be a storage room in which

lubricating oils or finishing materials are kept in quantity. It may be a dip-tank or baking oven. To protect spots like these there is a growing appreciation of the built-in carbon dioxide extinguishing system. A typical application would be a large quench tank.

Being filled with oil, the quenching tank has plenty of combustible material to cause trouble. As hot metal is repeatedly plunged into the tank, the oil gets hotter. Despite precautions, its temperature may reach the flash-point, and fire can occur without warning.

The size of a carbon dioxide extinguishing system is based on the surface area of the tank which it guards. The rule is 1⅔ lb. of carbon dioxide capacity for every square foot of tank area. To protect small areas cylinders of as little as 10 lb. capacity may be used. However, most installations employ 50-lb. cylinders, using as many of these as necessary. There are three parts to the extinguishing system: the cylinders of carbon dioxide, the tubing and nozzles which distribute the gas, and the controls which operate the system.

Best safety practice dictates that the cylinders be placed at an ample distance away from the fire hazard. They require practically no maintenance, it being necessary only to weigh them periodically to make certain that there has been no loss of their contents. Pipes lead the carbon dioxide gas from the cylinders to nozzles placed at strategic locations adjacent to or on the quenching tank. Nozzles are so arranged as not to interfere with the work. These nozzles are specially designed to deliver the gas rapidly and in large volumes to blanket the burning surface of the oil without turbulence which might spread the fire over the tank's sides.

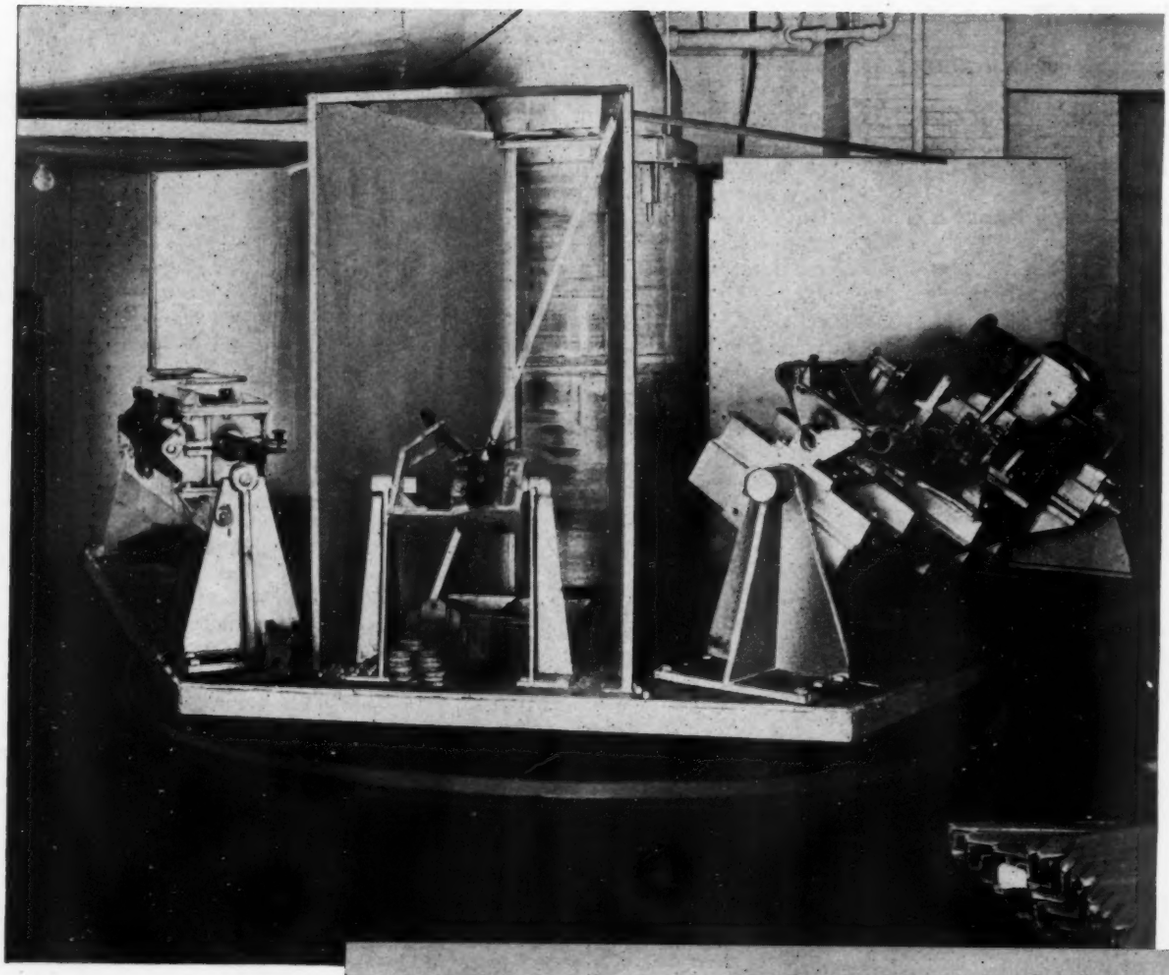
There is no residue from carbon dioxide gas. Small particles of "snow" may be formed during the discharge, but these disappear without leaving a trace of moisture or soilage. The gas itself harms neither materials nor equipment and, since it leaves no trace, there is no oil contamination, no mess to clean up. This means less interruption to production following a fire. If the blaze has been promptly extinguished, the working force need wait only long enough for the carbon dioxide gas to become dissipated—a matter of a minute or two—and for the oil bath to cool off. Work can be promptly resumed without time out for clean-up or replacement of contaminated oil.

Under ordinary working conditions a manually controlled release operates the extinguishing system. The break-glass pull-box must be located at a safe distance from the quenching tank, so that flames cannot prevent workmen from reaching the controls promptly. If automatic controls are considered desirable, a rate-of-temperature-rise detector is located above the tank. This detector is connected by small-bore tubing to a release device located over the cylinder bank. Temperature rises from weather or heat changes are discounted by a vent, but operation of the system occurs in the first few seconds when fire breaks out. Auxiliary manual control is also provided to augment the automatic actuators.

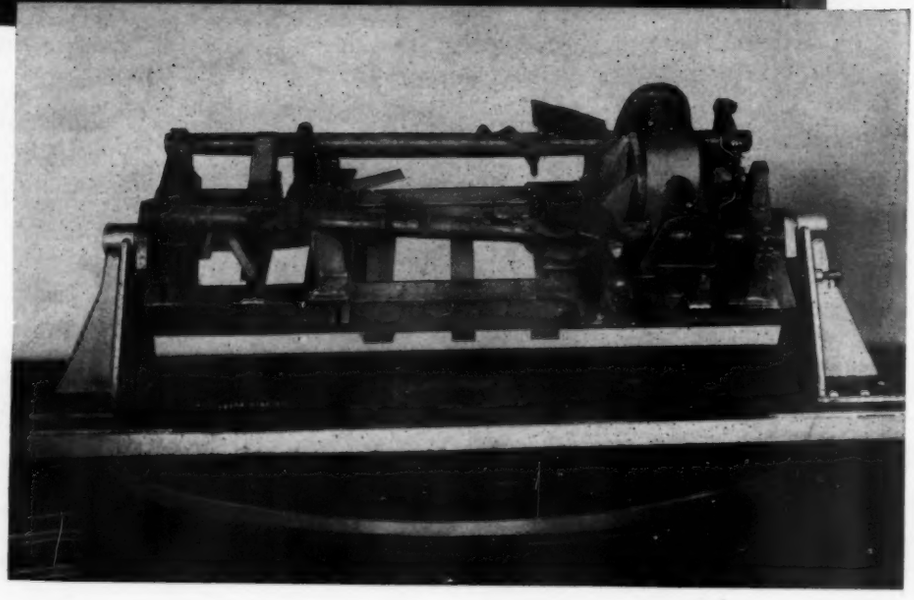
Often one bank of cylinders is used to protect two separate operations. The number of cylinders should be sufficient to take care of the larger tank. At the control box, a directional valve enables the workman to divert the discharge to whichever tank is on fire.

# Six-Fixture Table

BY J. B. MORGANTHALL, CHIEF TOOL



*All fixtures used in welding tractor frames are brought to the operator on this rotating platform. Metal partitions shield other workers from glare. Fumes are sucked away through a large vertical slot in the central drum*



*Trunnion-type fixtures are counter-balanced to permit rotation to any position. All fixtures, and the turntable itself, are of welded construction*

# Simplifies Welding

DESIGNER, JOHN DEERE WAGON WORKS

**Rotating platform carries all welding fixtures, brings them to operator in definite order**

ARRANGEMENT of fixtures for fabrication of small and medium sized parts always presents somewhat of a problem, since grouping them about an operator often causes materials handling troubles, while a straight line layout takes up too much floor space. Both these evils are circumvented with the revolving table illustrated, which occupies minimum floor space, simplifies materials handling, and lends itself to efficient ventilation.

The installation shown is used for welding the frames of light-weight tractors. Each frame consists of the following nineteen parts: two side members known as frame pipes, two front pivot support brackets for carrying the front axle, banjo housing, clutch pedal bracket, brake pedal bracket, right and left cross shaft brackets, two step plate brackets, two front implement brackets, steering gear bracket, two rear implement brackets, two rear engine support brackets and pivot support tie rod.

The rotary welding table was designed to carry all fixtures necessary to complete a welded tractor frame with one revolution of the table. This table is a hexagonal welded structure, 14 ft. in diameter, mounted on roller bearing casters running on a circular track. Each of the six fixtures is separated by sheet metal partitions extending from the table to an overhead canopy. They are fastened to the table, but pass under the canopy when the table turns. These partitions shield other workmen from flashes. The overhead canopy is a sheet metal structure hanging by rods over the welder's station.

Rotation of the table moves each fixture to the welder's station. All loading and unloading of fixtures is done on the opposite side of the table by a helper. The two partitions, overhead canopy and table form a compartment or cubicle directly in front of the welder.

The ventilating system includes a large drum suspended directly over the center of the table. The table is free to revolve beneath this drum. An opening 12 in. wide runs the entire height of the drum directly in front of the operator. Gases are removed through this opening by a large exhaust fan at the top of the drum. This fan blows gases out of the building through a duct above the canopy.

The following fixtures are mounted on the table: right hand frame pipe assembly, left hand frame pipe assembly, final frame assembly, three separate assemblies, draw bar assembly, and seat bracket assembly.

The right hand frame pipe welding fixture is a trunnion-type fixture made up of two halves, upper and lower. The lower half is fastened to the trunnions, while the upper half is hinged to the lower. Due to the fact that brackets must be welded to both the top and bottom of the pipe, a hinged-type fixture is necessary. Brackets are located and held in position with V-blocks and clamps. In several instances, where brackets have bored holes, the brackets are clamped by tapered plugs into bores and locked by bayonet locks. When all brackets are loaded into the fixture, the two halves are revolved together and locked; thus all brackets are located in their correct positions and the entire fixture may be revolved, at welder's desire, so as to be accessible to him and the electrode. This assembly contains five brackets and a frame pipe.

The left hand frame pipe is the same as the right hand fixture with the exceptions that the steering gear bracket is added and the fixture is left hand. This assembly contains six brackets and a frame pipe. All trunnion-type fixtures are counter-balanced to give freedom of movement to the welder. In both of these fixtures all locating brackets and clamps are built-up welded assemblies, and are attached to the fixed body with screws and dowels. This is done for economy of machining, as the fixtures are each 8 ft. long.

The final frame assembly fixture is also a trunnion type which is 9 ft. long and 2½ ft. wide. This fixture positions the frame pipe assemblies of the two previous fixtures, with two front pivot support brackets, two cross shaft brackets, and banjo housing, for welding into a finished tractor frame. The base of this fixture is of arc welded structural steel construction. Upon this base are mounted the various locating and clamping units. The two frame pipe assemblies are held in position at the rear by V-blocks and clamps. At the front they are located and clamped by the rear engine support brackets previously welded to the pipes. The two front pivot support brackets are held in position by sliding plugs locating the brackets against stop blocks. The sliding plugs pass through the bore of the brackets and are piloted in the stop block. These plugs, operated by levers which bring the brackets into their proper positions, are locked with wedges. The banjo housing at the rear of the frame is located by means of a locating plate with two dowels. The banjo is clamped with a jackscrew clamp. The frame pipes pass through the banjo housing casting and two beads of weld must be thrown around each pipe. The cross shaft brackets are each located with a pair of equalizing taper plugs which are locked by means of bayonet locks. This fixture is also counter-balanced, as the operator must revolve it completely to reach all points to be welded. When the welding operations on this fixture are completed, a tractor frame has been finished.

Sub-assembly fixtures are of the conventional type where clamping and locating are simple. These fixtures, made of structural steel, are built-up welded clamping brackets. The trunnion-type seat bracket fixture is counter-balanced. This fixture clamps and locates five small parts at one time, on which there are six welds to be completed ranging from small tack welds, to ¼-in. fillet welds 3 in. long.

In the design of all the foregoing fixtures, all castings for locating brackets, clamps, etc., were eliminated by fabricated welded units; thus the machining costs were reduced to a minimum. These fixtures and the rotating table make it possible to weld a complete tractor frame and sub-assemblies in 25 min. There are 156 in. of weld per frame. The bead is ¼ in. The cost of producing a frame has been reduced better than 50 per cent. An average of 20 frames are produced in 8 hours.

# Balancing rotating machinery

BY F. C. RUSHING, WESTINGHOUSE RESEARCH LABORATORIES

**The Dynetric principle of separating unbalances with electrical networks has a number of advantages. Direct readings and quick set-ups speed work**

THE EFFECTS of *unbalance* in a rotor are centrifugal forces and couples tending to cause it not to rotate about a line through the journal centers.

*Static unbalance* can be indicated in the same manner as weighing on a beam type of scale is done, Fig. 1. An unbalance $W_u$ will tend to fall to the lowest position, but a weight $W_s$ of an amount such that $W_u r_u = W_s r_s$ placed anywhere on the opposite side will balance it.

*Dynamic unbalance* is the couple produced by centrifugal forces while rotating with weights such as $W_u$ and $W_s$ a distance "$l$" apart.

*Running balance* of a rigid rotor is obtained when the forces and couples caused by centrifugal forces are in equilibrium. For example, in Fig. 2 unbalance $W_u$ is balanced by $W_{LD}$ and $W_{RD}$ when $C_u = C_{LD} + C_{RD}$ (centrifugal forces), and $C_{LD}b = C_{RD}l$ (centrifugal couple).

Any number of unbalances, such as $W_u$, in a rotor can be similarly balanced by weights in the transverse balancing planes containing $W_{LD}$ and $W_{RD}$. Furthermore, in each balancing plane the weights can be resolved into a resultant weight at a given radius such that the resulting centrifugal force is the vector sum of the individual forces. Therefore, since the unbalance of a rigid rotor can be corrected by one weight change in each of two arbitrary balancing planes, the total unbalance will be treated as unbalance in each of two planes.

Balancing machines can be used for segregating the effects of two unbalances of this kind so that each can be measured. Fig. 3 shows schematically a well known type in which vibration is taken as a measure of unbalance. The centrifugal force of $W_R$ will have a lever arm, $l$, about the fulcrum, whereas that of $W_L$ will have none; therefore, all vibration will be caused by $W_R$. Conversely, with the fulcrum in the plane of $W_R$, the vibration will be caused by $W_L$.

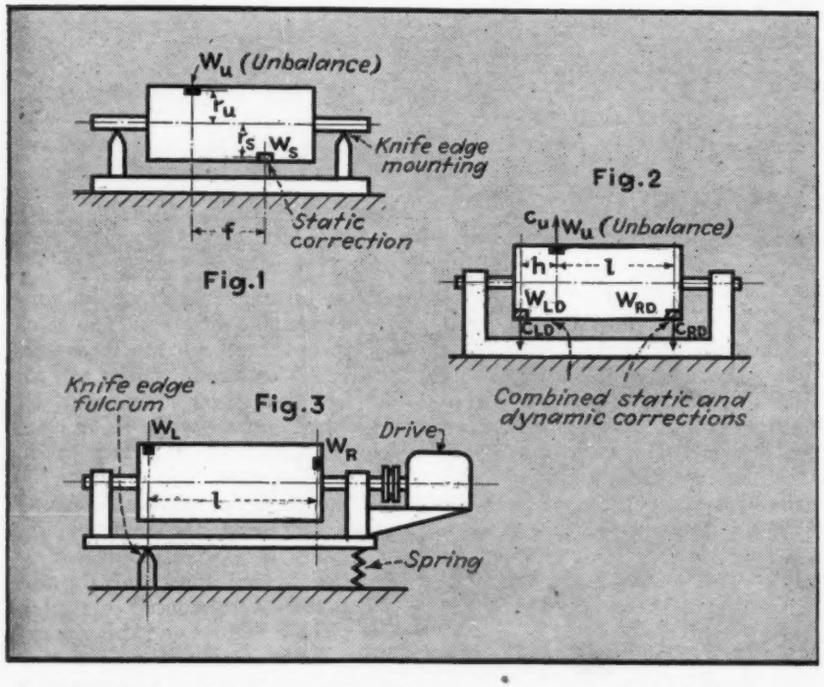



*Fig. 1—Static unbalance can be indicated much as weighing is done on a beam-type scale. Here* $W_u r_u = W_s r_s$ *when the rotor is in static balance. Fig. 2—Equilibrium of forces and couples caused by centrifugal forces is necessary to bring a rigid rotor into running balance. Fig. 3—The pivoted balancing machine separates unbalances mechanically*

## The Dynetric Principle

The hinged carriage, Fig. 3, serves as a mechanical means of separating the two unbalances, whereas the Dynetric principle enables this function to be performed electrically and gives greater freedom of choice of bearing supports and rotational frequencies.

A simple example will serve to explain this principle. Assume an unbalance $W_L$, Fig. 4(a), which when rotating will cause simple harmonic vibration of rotational frequency and of amplitudes $A$ and $cA$ at two points respectively along the rotational axis. Assume these vibrations to have either a 0 deg. or a 180 deg. phase relationship. The factor "$c$" represents an assumed constant relationship between vibrations at these points produced by any unbalance weight in the trans-

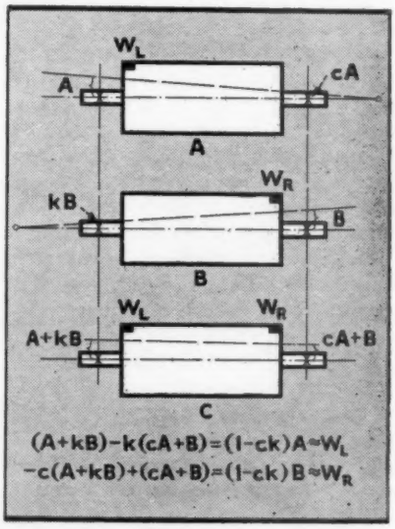



*Fig. 4—Sketches at* a, b *and* c *serve as a simple example to explain the Dynetric principle*

verse plane of $W_L$. Similarly, Fig. 4(b), $W_R$ will cause $kB$ and $B$ vibrations. Adding these unbalances, Fig. 4(c), gives vibrations $A + kB$ and $cA + B$.

Combining the two vibrations of Fig. 4(c) in certain proportions eliminates $B$, leaving only $A$, proportional *to* $W_L$. For example,

$$(A + kB) - K(A + B) = (1 - ck)\, A \approx W_L$$

This operation is accomplished easily by electrical means. Place linear electrical vibration pickups $P_L$ and $P_R$, Fig. 5, at the two pedestals and connect them in the circuit shown. Subtracting the $k$ part of $P_R$ from all of $P_L$ gives a voltage proportional to $A$ or $W_L$.

This electrical network setting can be determined experimentally by operating a rotor with zero $W_L$ but with a $W_R$. Then the adjustment to give zero voltage across the network output is the one desired. A similar treatment of another network switched across the same pickups will yield an adjustment to indicate $W_R$ but to cancel out the $W_L$ effect. Thus, voltages proportional to unbalances in each of the two arbitrary planes respectively can be obtained by electrically measuring vibration at two arbitrary points along the axis of rotation if "$c$" and "$k$" are constant and if the vibrations produced by each weight have either a 0 deg. or a 180 deg. phase relationship.

A machine using this Dynetric principle must contain: (1) means for supporting and driving the rotor; (2) electric vibration pickups; (3) electrical networks similar to Fig. 5, except for general application the adjustments must be suitable for $k$'s and $c$'s equal to, less than, or greater than one; (4) a means for metering the outputs of the networks; and (5) switching necessary for convenience of operation.

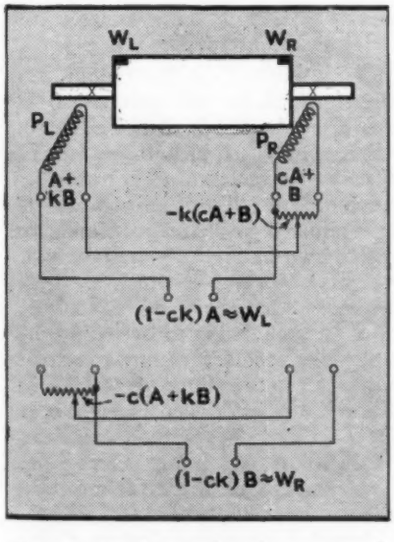



*Fig. 5—This two-bearing network for the Dynetric balancing of a rotor involves electrical vibrator pickups, a means for measuring the outputs of the network and the necessary switches*

*Fig. 6—Suitable for rotors weighing up to 7 lb., this Dynetric balancer indicates location of an unbalance by the flashing of a stroboscopic lamp. Speed during operation is held constant at same speed between 1,000 and 2,000 r.p.m.*

### Stroboscopic Type Balancer

A Dynetric machine for indicating unbalance in rotors weighing between ½ and 7 lb. is shown in Fig. 6. The rotor is supported on light, elastic pedestals which have the above mentioned 0 deg. or 180 deg. phase relationship and the constant "$c$" and "$k$" characteristic by virtue of their having only a small amount of damping and having an operation speed far above the natural frequencies of the system in the direction of vibration measurement.

The rotors are belt driven by a synchronous motor and can be operated satisfactorily at any constant speed between 1,000 and 2,000 r.p.m. An electro-magnetic vibration pickup is mounted behind each pedestal.

The two networks are in the cabinet. Each is made suitable for handling any value of "$c$" or "$k$", by having a reversing switch for each pickup and by having a means for switching the potentiometer from one pickup to the other.

The amount of unbalance is indicated by a meter switched across the appropriate network. Each network's output has a calibrating potentiometer for adjusting the relationship between meter deflection and network output, thus enabling the direct reading of unbalance amount. The unbalance location is indicated by having the output of the appropriate network control the flashing of a stroboscopic lamp. By means of this light an

image of the rotor is shown with the unbalance in the plane of the pointer. Identifying marks on the rotor enable recognition of the correct location. Near the operator's right hand are the Left-Right, Amount-Angle, and Sensitive-Insensitive switches.

The setup for a rotor is made experimentally as described above. The first perfectly balanced rotor of a given kind is obtained, without great difficulty, by a cut-and-try method of balancing on this machine. After a setup is obtained, dial and switch settings can be recorded for future use on the same type of rotor, and all future unbalance indications can be obtained quickly. Sequence of operations after original setup is made is: (1) Switch to "Left" and "Amount" and read meter, (2) switch to "Angle" and note position of rotor image, (3) switch to "Right" and note position of rotor image, (4) switch to "Amount" and read meter.

External disturbances such as floor vibration and belt roughnesses are eliminated by a band pass filter and spring-mounted pedestals and pick-ups.

In this machine unbalance sufficient to cause the pedestals to vibrate at 0.00004 in. total amplitude easily can be indicated. This is of the order of 0.001 oz. in. at one correction plane of a 2-in. diameter, 5-lb. rotor. The accuracy of unbalance indication for unbalances of the order of 0.05 oz. in. in a 2-in. diameter, 5-lb. rotor is within 5 per cent.

### Universal Dynetric Balancer

To balance rotors weighing between 25 and 6,000 lb., there is a direct-coupled machine which runs between 300 and 900 r.p.m. On each end of the balanced drive shaft is an elastic universal joint. The shaft slides axially for convenience in coupling. The pedestals are suspended by piano wire. When not running they are clamped automatically to enable working on the rotor in the machine. Electric vibration pickups are attached to the pedestals as in the previous case.

Networks similar to that in Fig. 5 are used for unbalance separation but the metering of their outputs is done by means of an indicating wattmeter type of meter and a two-pole sine wave generator coupled to the drive. For these relatively low speeds it is undesirable to use the stroboscopic method because of lamp "flicker" and the difficulty of making a tuned filter for low frequencies. The network output, which is determined by the unbalance, is amplified and put into the voltage coil of the meter. The generator output, whose phase is related to the angular position of the shaft, goes into the current coil of the meter.

Since the indication of the meter is proportional to the product of the voltages across its coils multiplied by the cosine of the angle between them, it is possible to make it read zero or a maximum by angular adjustment of the generator stator, thereby changing the phase of its output. This stator is rotated by the handwheel in front of the operating cabinet and its angular position is indicated by the protractor to the right of the cabinet and immediately behind the starting button. The zero reading requires an accurate adjustment of the stator position. Angular position of the stator for this zero reading can be taken as an indication of the phase angle of the unbalance because it relates the phase of the unbalance to an angular position of the shaft. Shifting the phase of the generator 90 deg. from this zero position gives a maximum deflection of the meter, which is an indication of the amplitude of unbalance being measured. This 90 deg. phase shift is obtained by switching to a second winding 90 deg. away from the one in the circuit when the stator adjustment was made.

The generator voltage across the current coil of the meter is made a pure sine wave of running frequency; and because equal frequencies on both coils are required for producing a resultant torque, this method of measurement effectively filters out all harmonics except that corresponding to running frequency. This characteristic makes the apparatus suitable for use where floor vibration is prevalent.

To facilitate balancing the first of a new type of rotor before a setup has been made, initial unbalance effectively can be eliminated by compensating voltages in series with the initial pickup voltages; then, so far as the circuit knows, the rotor is balanced.

The sensitivity and accuracy of this machine in terms of vibration amplitude is about the same as was given above for the stroboscope-type machine.

Seldom does a rotor require having its unbalance indicated at or near its operating speed when it is not too large to permit its being balanced on one of the Dynetric machines described above. High-speed balancing of a rotor is, however, necessary when it is of a type that large centrifugal forces cause it to have excessive unsymmetrical distortion.

The Dynetric principle is not limited by rotational frequency and can be applied to unbalance indication of rotors while they are running at high speed. It has a practical advantage of not requiring that the rotor support vibrate around a specific axis, as is required by the machine shown schematically in Fig. 3; and the advantage is significant because attempting to obtain vibration around a specific fulcrum axis where large dynamic forces are present is fundamentally difficult.

### Crankshaft Balancer

Many crankshafts are forged so that the unbalance falls within a region where components of weight from positions such as *A, B, C* and *D* in Fig. 7 can be removed to correct the unbalance. A special application has been made to indicate the unbalance components at each of four predetermined points.

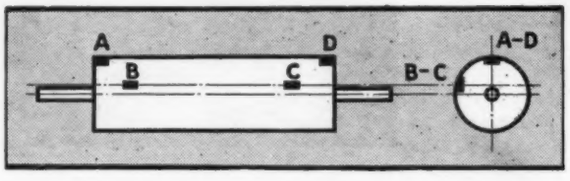



*Fig. 7—Weight may be removed from positions* A, B, C *and* D *when dynamically balancing many forged four-throw crankshafts*

Another way of considering the Dynetric principle is that it eliminates effects which are not desired; so in this case when *A* is to be indicated, voltages produced by unbalances at *B, C* and *D* must produce no meter deflection. The effect of unbalance at *D* is eliminated by a network similar to that shown in Fig. 5. The effects of weights at *B* and *C* which are in a common axial plane, not containing *A* or *D*, are eliminated by setting the sine wave generator stator at such an angle that the readings for weights at *B* and *C* are zero. Then a weight at *A* is the only one of the four which can produce a meter reading. Three other similar setups are made for metering unbalances at *B, C* and *D*.

In this machine two sine wave generators are required. One will not allow voltages from *B* and *C* to cause a meter deflection and the other will not allow voltages from *A* and *D* to cause a meter deflection. In addition there are four networks. In practice

*Fig. 8—A portable wattmeter-type vibration measuring unit is available for balancing machinery in the field*

one set-up usually suffices for a long time so the network adjusters are covered and the generator adjuster handles are removed. For metering purposes, metering potentiometers are used to buck down the meter reading to zero.

In operating this machine after it is set up, switch to *A* and adjust potentiometer *A* to make the meter read zero and then switch to *B, C* and *D* and make similar adjustments with potentiometers *B, C* and *D*. Then the angular positions of these potentiometers are an indication of the amounts of unbalance in each of the four predetermined locations. As an additional accessory, synchrotie motors can couple each of these metering potentiometer shafts to a stop on a special drill press, thus causing the drill press to be set up automatically so that when the crankshaft is placed in it the correct amounts will be drilled from each of the four locations.

### Field Balancing

For balancing machinery in the field under operating conditions or in arbitrary types of pedestals, a portable wattmeter-type of vibration measuring equipment. Fig. 8, similar in principle to the metering arrangement on the universal machine, will give rapid, accurate vibration measurements. This apparatus consists of a two-pole sine wave generator to be coupled to the unbalanced rotor, a vibration pickup, and a meter assembled with switches for convenience of operation. The unbalance can be calculated from the vibration measurements, or electrical networks could be used to do the calculating for this type of balancing.

These production type Dynetric machines are characterized by giving rapid, accurate unbalance indications because:

1. No driving-motor speed adjustments are required.
2. Readings of all unbalance corrections are made in a single run without stopping the rotor.
3. Adjustments for each rotor are not necessary before taking readings.
4. Readings are direct in convenient units. Curves or calibration charts are not required.
5. Errors of indication have been reduced to minimize the runs required.
6. The machines are not hindered by building or floor vibrations.
7. Changes in setup from one type of rotor to another can be quickly made, provided the dial settings are known.

## Long-Life Engines

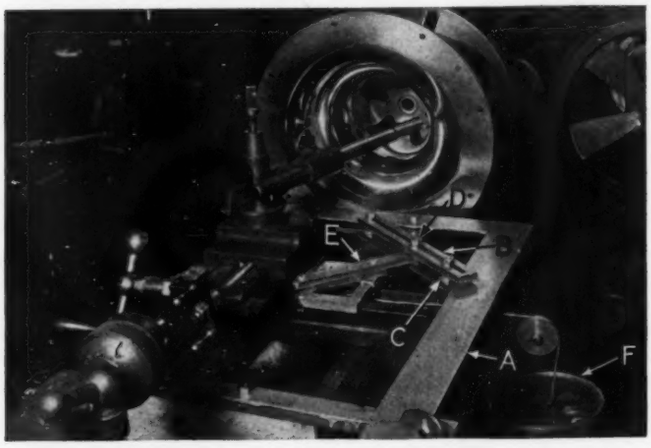
WHILE AVIATION ENGINES give astonishing life from the mileage point of view, we are likely to consider them as being short-lived when measured by months and years. So it is somewhat surprising to learn that the Curtiss-Wright Company, and presumably others, are still supplying spare parts for engines built in 1925. This reminds us of the longevity of the Model T, the OX-5 and the much-discussed Liberty.

# IDEAS FROM PRACTICAL MEN

## Attachment Generates Elliptical Surfaces

BY GEORGE J. OEHMKE

The lathe attachment herein described was devised when several orifices with quarter elliptical approaches were needed for steam and air-flow measurements. Some of the advantages of the device are its adaptability to any engine lathe, the ease and accuracy with which the major and minor axes may be adjusted,




*This lathe attachment can be used for generating elliptical surfaces without the aid of a templet and with a minimum number of measurements*

the freedom from working to a templet and the few measurements required. After the throat has been bored to size and axes set, no further measurement is necessary until the polishing is almost completed.

The parts comprised a steel square *A*, a four-bar guide *B* for holding rollers *C* and a center pin *D*, a connecting link *E* from the center pin to the lathe crossfeed, and a weight *F* for holding the rollers in contact with the square.

The carpenter's steel rafter square *A*, which had been checked and dressed for accuracy, was clamped to the lathe bed as near the headstock as possible without interfering with the work, and high enough to clear the slides of the carriage as far as the crossfeed. A dial indicator was used to check the parallelism between the square blade and the lathe ways. The connecting link *E* was rigidly attached to the crossfeed slide at a 45-deg. angle, the horizontal center line being in the plane of the square *A*. The outer end of this link was drilled for the center pin *D* of guide bar *B*. The guide bar was adjusted by clamping a roller pin near one end of the lower half of the unit; the center pin was then placed at a distance equal to the major axis and the other roller pin at a distance equal to the minor axis, these measurements being made with a vernier caliper or micrometer.

In generating the elliptical surface, a casting was placed in the chuck and bored to within 0.002 in. of the finished size. The crossfeed screw was then disconnected. With the rollers on their pins, the center pin was put in the hole of link *E*, attached to the crossfeed slide, and the top half of the guide *B* was clamped on. The flexible wire, after being attached to the crossslide, was passed over a pulley on the back of the carriage and provided with weight *F* to keep the rollers in contact with the square. A light spring attached to the back end of guide *B* pulled toward the tailstock to start the guide *B*, traveling along the back edge of the square. The compound slide was set parallel to the lathe bed and the boring bar placed in position. The cutting tool must be ground to a sharp point, set in the boring bar at a 45-deg. angle and facing downward on the exact horizontal center line of the work; the cut must be made on the back side of the nozzle, starting inside and feeding outward. A very fine transverse feed is necessary when the curve of the ellipse becomes tangent to the face of the nozzle.

For nozzles of less than 1-in. throat diameter, the center pin must extend above the guide bar *B*, so that the link *E* will clear the guide rollers.

When machining circular approach sections, the rollers are set equidistant from the center pin *D*. If the finishing cuts are light, a satisfactory surface may be obtained by polishing with fine emery cloth and paper.

## Speeds Removal of Stove-Bolt Nuts

BY R. O. BELLINGHAUSEN

We recently received 100 gross of 1-in. and ¾-in. stove bolts, in which each bolt was packed with the nut partially threaded. To remove the nuts by hand meant much lost time in a very unproductive type of work. The time was cut to practically nothing by the following method:

A cardboard box, measuring one foot on the side and open on one end, was placed on its side with the open end facing the operator. A hole was cut into the bottom of the box, and the spindle of a ¼-hp. motor was placed through it. A 5-in. circular fiber brush was slipped over the spindle and a gross of stove bolts placed on the table before the box opening. The operator started the motor, rotating the brush in a counterclockwise direction, and touched the nuts to the brush. Both hands could be used and the nuts were removed as rapidly as it was possible to pick up and drop the bolts.

## Sine Bar That Can Be Used for Wide Angles

BY F. E. CLARKE

The illustrated adjustable sine bar was designed for holding angular work on the boring mill, miller, planer, drill press, or slotter. It is rigid and can be set quickly in a positive and accurate position, and cannot easily be moved from that position.

Base *A* and work plate or top cover *B* are of welded construction and hinged together at one edge with two rigid hinges, such as shown in Section *X-X*. Sine bar *C* is located accurately 10 in. from the center of the hinges. When the top plate *B* is set at zero angle, the sine bar rests on two steel plates *J*, which are hardened and ground, and held in place with screws through the bottom of base plate *A*. The work plate can be set easily at any desired angle by placing blocks *D* of the correct length under the sine bar.

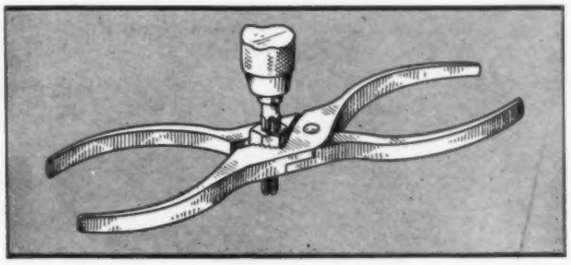
The length of the blocks used is simply ten times the sine of the angle desired. After dropping the sine bar onto the blocks, the nuts on the hinge pins are tightened to hold the work plate *A* on the blocks. The two hinge pins should be threaded with fine right-hand and left-hand threads and so placed that when tightening the nut, a turn of the wrench will tend to force the sine bar down on the blocks rather than raise it up.

If the nature of the work is such that there is danger of lifting the work plate off the block *D*, it may be held more rigid by the use of a turnbuckle (not shown) between lugs *L* and *K*, and by two supporting braces (not shown) hinged on bolts at the top end through holes *M* and *N*. These braces should be slotted at the bottom end to allow for adjustment, and should be of the proper length for the work at hand; they are clamped at the lower end with bolts through holes *O* and *P*. The turnbuckle and braces are helpful in working angles from about 50 to 95 deg. from the base.

The graduated segment *E* is screwed and doweled to base plate *A* and fits into a counterbore flush with the edge of top plate *B*. This segment is used as a double check on all settings, and is especially helpful for angles greater than 50 deg.

The work surface on the top plate *B* may have T-slots for bolts and keys for lining up the work, or it may be drilled and threaded for hold-down bolts.

Section *X-X* shows one hinge in detail. Hinge pin *F* is hardened and ground, is a drive fit in base *A*, and a tight running fit in the hardened and ground bushing *G* in top plate *B*. Tightening the nuts brings friction on the hardened and ground thrust washers *H* between the top and bottom plates.



*Pliers with double grip meet many shop needs such as retapping nuts and removing studs and pipe nipples*

## Pliers with Double Grips Have Many Uses

BY CHARLES H. WILLEY

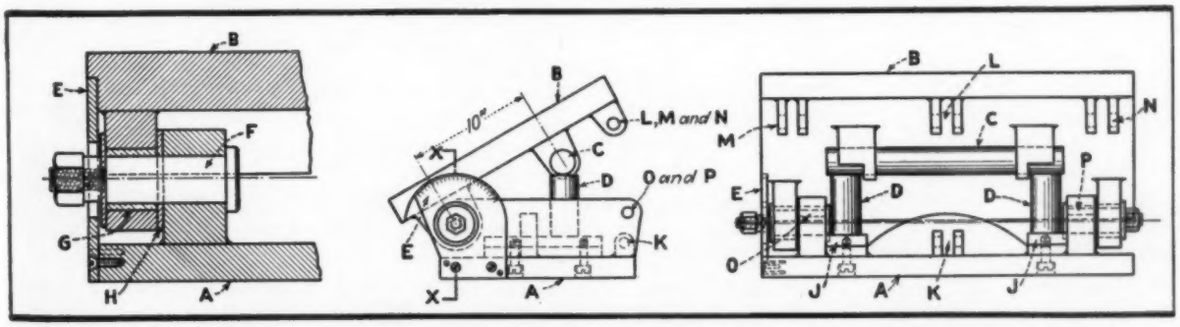
The tool shown in the drawing was designed to hold nuts when retapping threads and to remove studs or short pipe nipples. It was made from a pair of heavy pliers by welding the extension handles on the noses as shown. It meets all needs where a quick two-handed grip is needed, and where a wrench would be too slow, or would not provide the grip required.

## Simplified Acid-Etching of Steel

BY LOUIS deL. BERG

More and more it is becoming the practice to mark duplicate parts with the part number, inspector's stamp or other data using a rubber stamp and etching fluid. For steel I find the nitric-acid, nitrate-of-silver formula given in the American Machinists Handbook very efficient.

The common practice, at least in the shop where I am employed, is to have a bottle of etching fluid stoppered with a half-eaten cork or wad of paper which is used to drop the acid on a ground glass plate. The acid is distributed evenly by rubbing it




*This sine bar is fitted with lugs and supporting braces to maintain the accuracy of the work at angles of 50 to 90 deg. A protractor is built into the sine bar as a check on all angle settings*

with a second glass plate. In this process, more fluid than is needed is generally used, and results in a messy application. After application of the stamp to the metal, the etching process is stopped by applying a drop of oil. The procedure I use avoids excessive use of the acid, and speeds the etching operation.

The acid is kept in a wide-mouth bottle with a rubber cork through which is passed a medicine dropper. A discarded tin or jar top is used to hold the oil for stopping the etching action. A piece of sponge rubber completes the equipment. I keep these three items mounted on a wooden block. A small amount of plastic wood will seal the bottle and oil container in the block.

The acid is applied to the sponge rubber, which serves as a stamp pad. It will be found that the acid is not absorbed as readily as by cloth or blotting paper, but absorption by the rubber can be accelerated by rubbing the acid into the sponge with the small end of the dropper. Considerable acid will be taken up by the rubber, and it will remain moist for some time.

When I use my inspector's stamp, which is about $\frac{1}{4}$ in. diameter, the acid is transferred from the rubber sponge to the stamp and then to the steel, where it is held until sufficient etching action has taken place. Then I dip the end of my finger in the oil, touch the etched portion with it, and immediately wipe it off with a rag. This is a considerable improvement over the etching method previously used, and certainly has accelerated the procedure.

## V-Block Aids Accurate Drilling of Oil Holes

BY EVERETT McDONALD

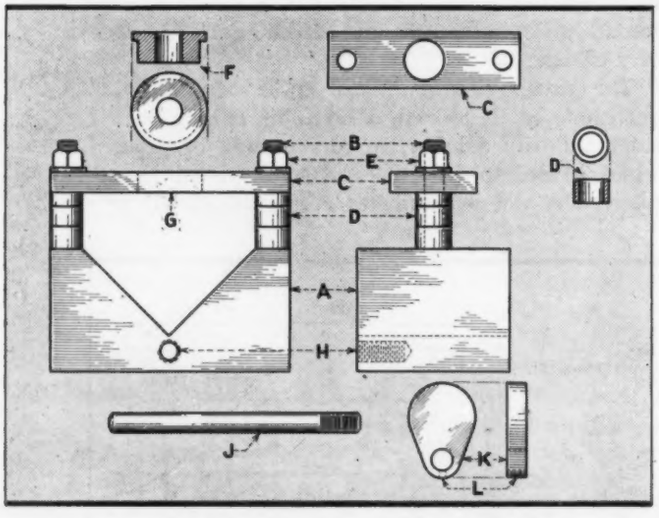
In drilling small round pieces for cotter-key or oil holes, it is customary to hold the work in a V-block or vise. However, even after the work is center punched for the drill, very often the drill hole is not in the center of the piece. In addition, it takes considerable time to line up the drill. The device shown in the drawing eliminates these difficulties.

The V-block *A* is drilled and tapped for two studs *B*. Plate *C* is raised and lowered on the studs by spacer-bushings *D*, and when the desired height is reached, the plate *C* is held by clamping nuts *E*. Several size bushings *F* may be made to fit the center hole in the plate. The bushing hole corresponds to the size of drill required.

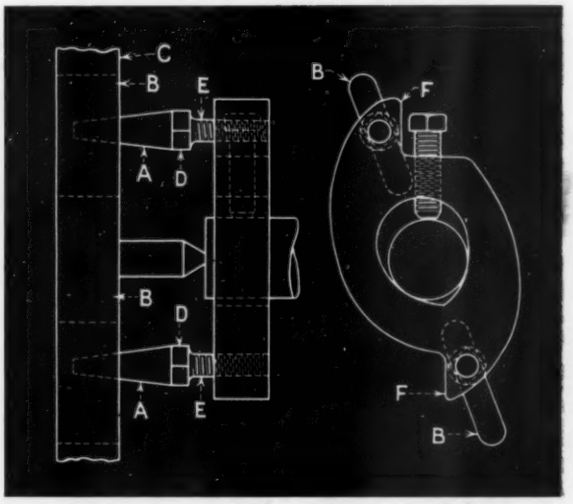
The bottom of the V-block is drilled and tapped at *H* to take rod *J*. Stop *K* slides upon rod *J* and is held in position by a setscrew at *L*.

When a piece of work is placed in the V-block, the plate should be lowered or raised until it is within $\frac{1}{8}$ in. of the part to be drilled. A bushing corresponding to the size of hole is then placed in plate *G* to guide the drill directly through the center of the work.

In the event several pieces are to be drilled with the holes in exactly the same location, rod *J* and stop *K* can be used to locate them.




*This V-block can be used for drilling accurately cotter-key or oil holes directly through the center of the work piece. A stop can be used for drilling holes in the same location on succeeding parts*




*This lathe dog, with tapered pins on opposite side of the work, provides a balanced drive. The projections on the dog are to prevent the head of the setscrew from catching in the operator's clothing*

## Lathe Dog With Balanced Drive

BY GEORGE C. LAWRENCE

The lathe dog shown in the drawing was designed for balanced drive. This is accomplished by means of tapered pins *A* which are screwed into the dog and engage the slots *B* in the faceplate *C* by using a wrench on the squared portions *D*. When the tapered pins are in contact with the sides of the slots, all backlash is prevented.

The pins may be provided with locknuts on the threaded portions *E*. The projections *F* on the dog are to prevent the operator's clothing from catching on the heads of the set screws.

# Armament

SECTION OF AMERICAN MACHINIST

## Machine Work on Trench Mortars

BY E. H. FISHER
*Works Manager,*
*A. B. Farquhar Company*

# MACHINE WORK ON TRENCH MORTARS

Close dimensional tolerances have been held without much difficulty in the production of parts for trench mortars by careful design of small tools

By E. H. FISHER
Works Manager, A. B. Farquhar Company

MANUFACTURE of 81-mm. mortars and mounts for the U. S. Army does not involve the production of a large number of parts per unit, nor is much special manufacturing equipment needed. Standard milling machines, turret and engine lathes, grinders, drill presses and other equipment commonly found in machine shops are all that are necessary. However, these machines must be in good condition, capable of turning out accurate work, and must be equipped with precision jigs, fixtures and cutting tools in order to turn out parts within the dimensional tolerances required.

The four parts for the mortar and mount which involve the most difficult machining operations are the barrel, the base cap, the gear case and the yoke. The latter is machined from a malleable iron casting, using a Cincinnati No. 2 universal miller. Each operation on this part is jigged, in order that the dimensional tolerances of 0.0007 in. for hole spacing and alignment may be met. Drilling is done at 80 to 90 ft. per min. with a feed of about 1 in. per min. Reaming is done at a little lower surface speed, and with $\frac{3}{4}$ in. per min. feed. A tapered dovetail slot at one end of this yoke must be located accurately with relation to the shock-absorber and traversing screw holes. The fixture used for this slot is indexed for milling the taper, and has hardened tool steel setting blocks for locating the milling cutters accurately.

### Tubing Turned for Barrel

The gun barrel shown in Fig. 2 is made from a 48-in. long SAE-2330-W.D. seamless steel tube measuring $4\frac{1}{8}$-in. outside diameter and 3-in. inside diameter as received from the mill. Hardness of this tube is about 220 Brinell. The tube first is rough and semi-finish turned, and faced in an American 14-in. heavy-duty engine lathe, using carbide tipped tools at 230 surface ft. per min. The roughing cut removes approximately 3/16 in. on the diameter, while the semi-finishing cuts bring the outside diameters within 0.015 in. of finished size. The turned barrel must be a true cylinder so it will fit centrally in the cradle fixture used for boring operations. Also, the rough bore of the tube must be concentric with the semi-finish turned outside diameter

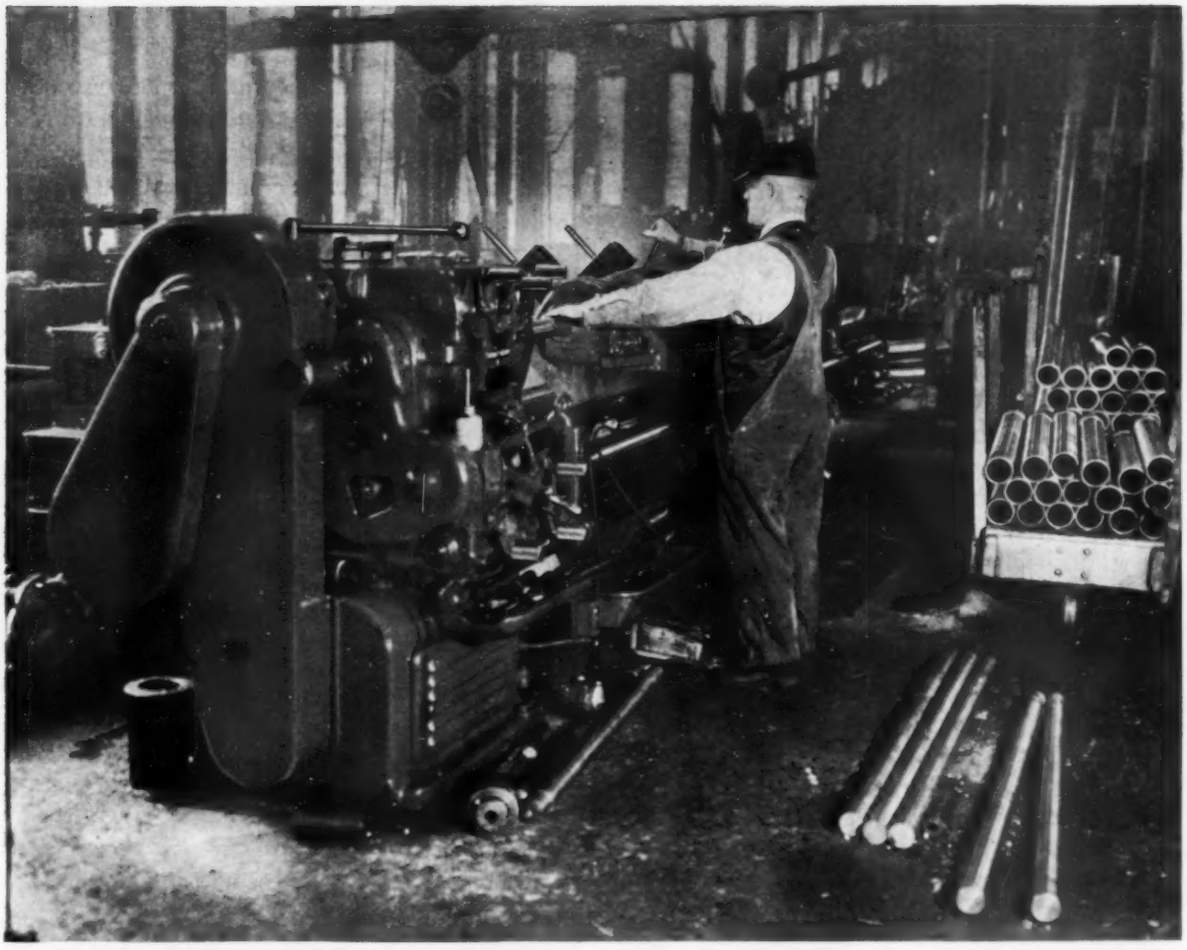
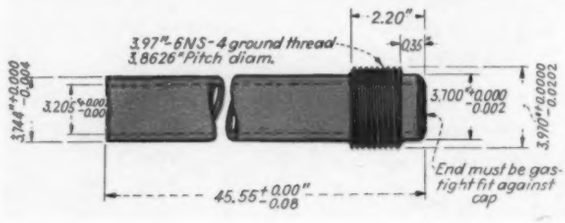


Fig. 1—A special cradle mounted on the carriage of this American 18-in. heavy-duty engine lathe, in place of the standard cross-slide, positions the barrel tube for all boring operations and for rolling in the bore for final finishing

Fig. 2—Machined in engine lathes, except for the grinding of threads at the base end, the barrel tube weighs approximately 40 lb. when finished. A Jones & Lamson thread grinder is used by a subcontractor for grinding the Class 4 threads from the solid




in order that an even cut will be removed by the first rough boring operation.

The American 18-in., 16-ft. bed heavy-duty engine lathe used for the boring operations is equipped with a special cradle fixture mounted in place of the regular cross-slide on the carriage. The cradle is removable, so that a cross-slide can be mounted when the lathe is used for other work. The cradle fixture, shown in position in Fig. 1, has guide bearings at each end to support the boring bar. Clamps at each end of the cradle are counter-weighted for easy operation, and hold the barrel central with the axis of the lathe spindle.

### Nitrided Bar Withstands Wear

The Davis boring bar used for all boring cuts is $2\frac{1}{2}$ in. in diameter and 12 ft. long. Design of this bar is such that it is locked into the spindle of the lathe for driving, and is supported by a roller bearing center at the tailstock end of the lathe. The bar is nitrided

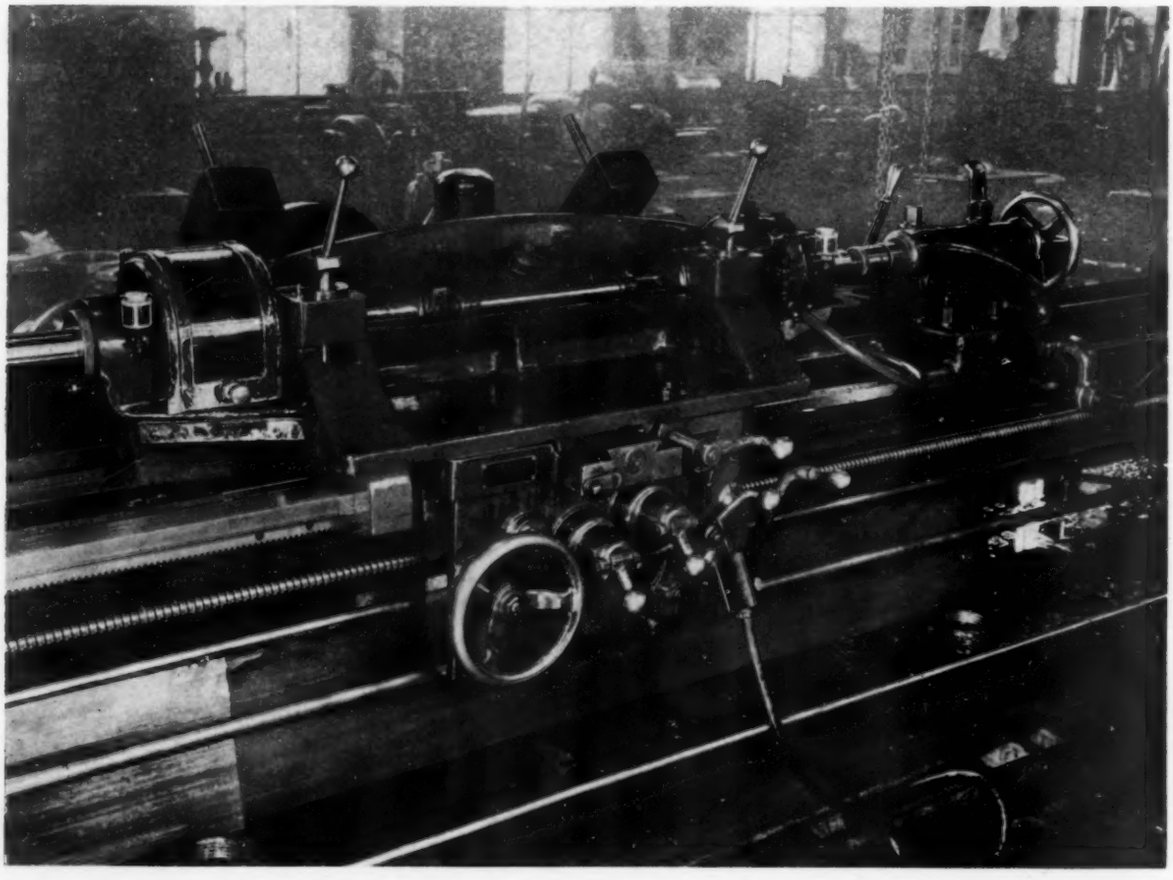
along that portion of its length that extends through the barrel during the boring operation, so that it will withstand the wear caused by the rubbing of chips.

### Floating Tool for Finishing

Three boring cuts are taken. The first roughing cut removes about 0.050 in. on the radius, and is taken at 52 r.p.m. Feed is 0.023 in. per rev. In this and other boring cuts, the carriage traverses the barrel along the rotating boring bar, the bar having no axial adjustment in the spindle. Stellite-tipped bits are used in the boring tool blade, which is of standard Davis design.

The second, or semi-finish boring cut also employs Stellite-tipped bits in the cutter head, and is taken with 0.017 in. feed per revolution at 52 r.p.m. Depth of cut is about 0.012 in. A floating tool made from Cobalt steel and shaped somewhat as shown in Fig. 3, used for the finish boring cut. This cut removes very little stock, and is taken at 38 r.p.m. with 0.017 in. per revolution feed. The finish boring operation produces a bore measuring between 3.204 and 3.205 in. diameter. As is shown in Fig. 3, the floating blade has a sharp lip at each end and is held in the boring bar by means of a setscrew, clearance being provided between the point of the setscrew and the blade, so that the blade will float in the bore. The setscrew is provided only to keep the blade from falling out of the bar when the work is approaching the cutter. Socony-

Fig. 5—Details of the cradle fixture used when boring 81-mm. mortar barrels are shown in this illustration. A straight, accurate bore is obtained by guiding the boring bar in bearings at each end of the fixture mounted on the lathe cross slide



Vacuum DTE oil is used as a cutting lubricant. This oil was selected after extensive tests in which a number of various coolants were tried. Although somewhat more expensive, this oil seems to give the best results when delivered under pressure to the rear end of the tube. Chips are washed out of the tube behind the cutter as it passes through the bore of the barrel.

### Barrels Rolled After Boring

After a lot of 40 to 50 barrels have been bored, they again are placed in the cradle on the 18-in. American Lathe for finish-rolling the bore. The Faessler-Maupin roller head used for this operation is adjustable between 3 and 3¼ in. with micrometer-adjustment collars. The seven rollers in the head are set at a slight helix angle, and are checked with a micrometer after having been set to size. The head which is similar to that shown in Fig. 4, is flexibly connected to a bar of sufficient length that the head may pass through the entire length of the barrel bore. The other end of the bar is connected to the spindle of the lathe. After the finish-bored barrel has been clamped into position in the cradle, it is brought forward until the rolls are just started into the bore. The lathe then is started and the rotating roller head draws the carriage forward so that the barrel passes over the head. Only the helix angle of the roller head provides feed for the carriage. No hand or other power feed is employed. This operation requires approximately one-half hour with a spindle speed of 52 r.p.m., and gives a mirror finish to the bore. The tolerance of 0.002 in. on the bore diameter is easily held. Oil under pressure is fed into the bore of the barrel during this operation, as it was during the boring operations. Details of the cradle are shown in Fig. 5.

Followng the rolling operation, the barrel is removed from the cradle and returned by truck to the 14-in. American lathe for finish turning the outside diameters and facing the tapered seat at the base end. This double chamfer at the base end must be smooth and square with the axis of the bore, so that a tight gas seal will be formed when the base

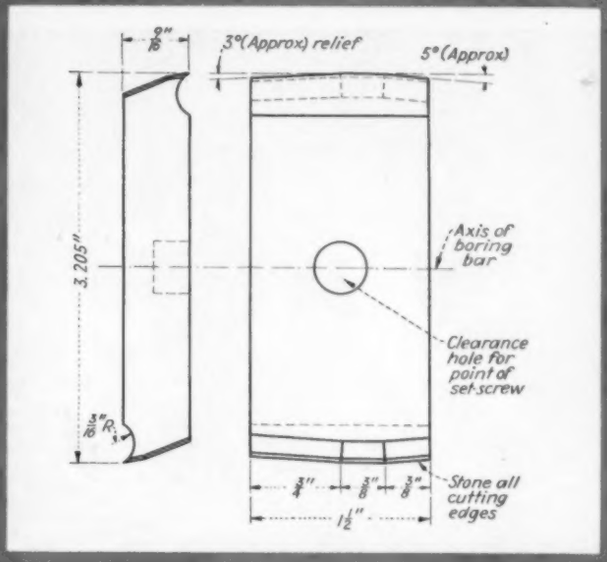



Fig. 3—A floating-reamer blade is fitted in the Davis bar for a final cut in the barrel. Cobalt steel has given best results

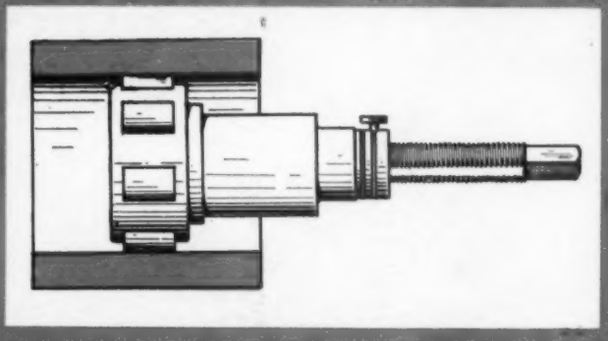
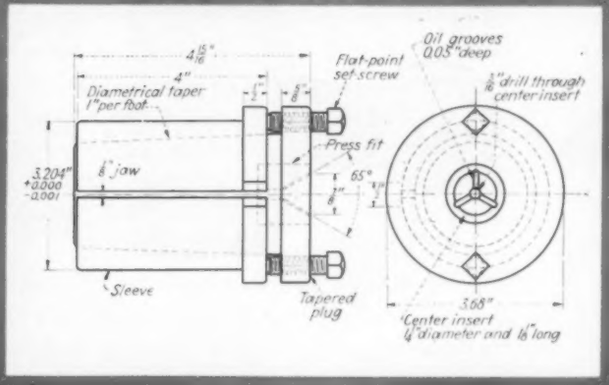
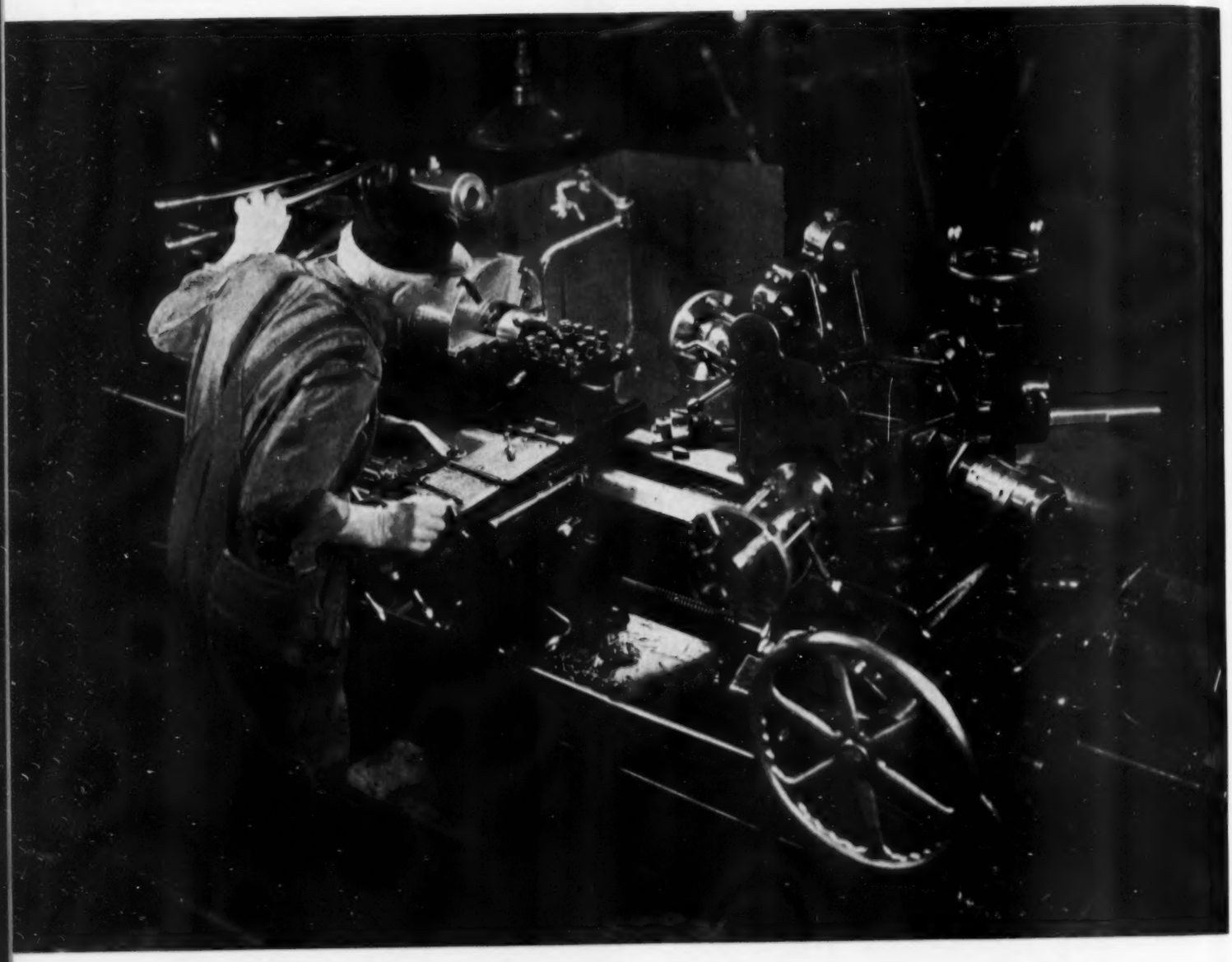


Fig. 4—Originally developed for applying bushings and brasses in railroad shops, the Faessler-Maupin roller head gives a mirror-finish when used in the 81-mm. mortar

Fig. 6—Developed at Watervliet Arsenal, two of these expanding centers are used for the finish turning operations on the barrel tube





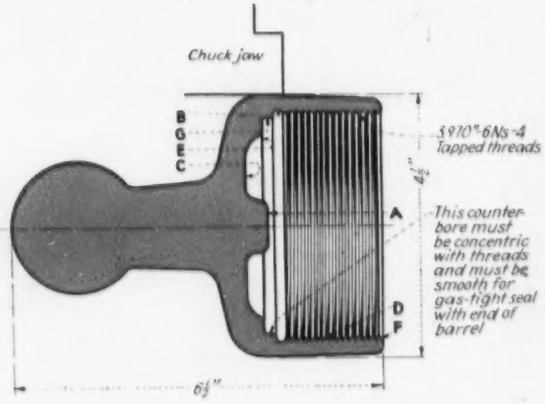



Fig. 7—Two chuckings are necessary for turret lathe operations on the forged-steel base cap. The set-up shown is used for the cup end, a similar arrangement on the same machine finishes the ball end

Fig. 8—Operations on the large end of the forged steel base cap are performed with the tooling set-up shown in Fig 7. The forging, made from SAE1035-W.D. steel, has a Brinell hardness of 200 to 220

cap is assembled on the end of the barrel. For this final turning operation, an expanding center, such as is shown in Fig. 6, is inserted into each end of the bore, so that the outside diameter will be concentric with the bore when finished. Carbide-tipped tools are used for the finish turning operations. The sleeve of the expanding center shown in Fig. 7 is made from SAE-1095 steel, hardened and ground, having a Brinell hardness of from 240 to 260. The tapered plug is turned from SAE-1020 steel, while the hardened center insert in this plug is made from SAE-1095 steel. This insert has three 0.05-in. deep oil grooves, and is pressed into a cavity bored in the outer end of the tapered plug. The two flat-point setscrews are used to release the tapered slug from the sleeve, so that the expanding center can be removed from the end of the barrel at the completion of the finish turning operations.

Following finish turning, the barrels are checked carefully to make certain that all dimensions are within the tolerances allowed on the drawings, then the barrels are shipped to a sub-contractor who grinds the Class 4 threads from the rough in a Jones & Lamson thread grinder. These threads must be held carefully within the allowed limits, and must be concentric with the bore of the barrel.

### Threads Finished by Grinding

Finished barrels are delivered to the Ordnance Department inspector for final approval before assembly with base caps to form a finished gun tube. The Ordnance Department inspector examines the barrel carefully for any flaws, and uses a number of very accurate gages to determine whether all dimensions are within permissible tolerance. A Pratt & Whitney star gage is used to check the bore of finished barrels.

Made from a SAE-1035-W.D. steel forging, the base cap is, for the most part machined in a No. 1A Warner & Swasey universal hollow hexagon turret lathe. Two chuckings are used for machining the two ends of this cap, the first set up being shown in Fig. 7. Before delivery to this machine, the cavity is roughed out in a drill press using increasing sizes of standard drills, the last being a flat bottom drill which roughs the cavity to about 3½ in. diameter and 2⅛ in. deep.

First chucking operations in the turret lathe on this base cap involve the use of tools on both the cross-slide turret and the hexagon turret, as indicated in Figs. 7 and 8. First operation is to face off the back seat *A*, Fig. 8. with a forged high-speed steel tool held in the cross slide turret. A special gage is used to insure facing this surface to accurate depth. Next, the groove *B* is machined with another forged high-speed steel tool in the cross-slide turret. A heavy forged high-speed steel tool in the cross-slide turret then is used to hog out material from the relief at *C* so as to relieve the load on a formed boring tool used in a later operation.

### Formed Cutter for Cap

The next operation consists of finish boring surface *D* for the threaded section. A heavy-duty boring bar carrying a high-speed steel bit is held in the cross slide turret for this operation. Following this boring operation, the surfaces *A* and *C* in the bottom of the bore are finished with a special high-speed steel formed cutter supported in the No. 1 position on the hexagon turret. Upon completion of this operation, the turret is indexed 180 deg. and a single-point tool held in a boring bar at the No. 4 position is used to chamfer at *F*.

The final turret operation before tapping is the rough counterboring of the surface *E* back of the groove *B*. This is done with a heavy high-speed steel blade held in the No. 3 position of the hexagon turret. The blade cuts at both ends and floats in its holder so as to maintain an even cut. This arrangement is especially desirable on surface *E*, as the final finish on this surface must be smooth so that it will provide a gas-tight seal with the end of the mortar barrel.

For tapping, the hexagon turret first is indexed to the No. 2 position, where a Landis collapsible tap of 4-in. capacity equipped with special chasers is used for rough tapping the 3.97-6NS-4 thread. Four to five passes are taken with this roughing tap, expanding the

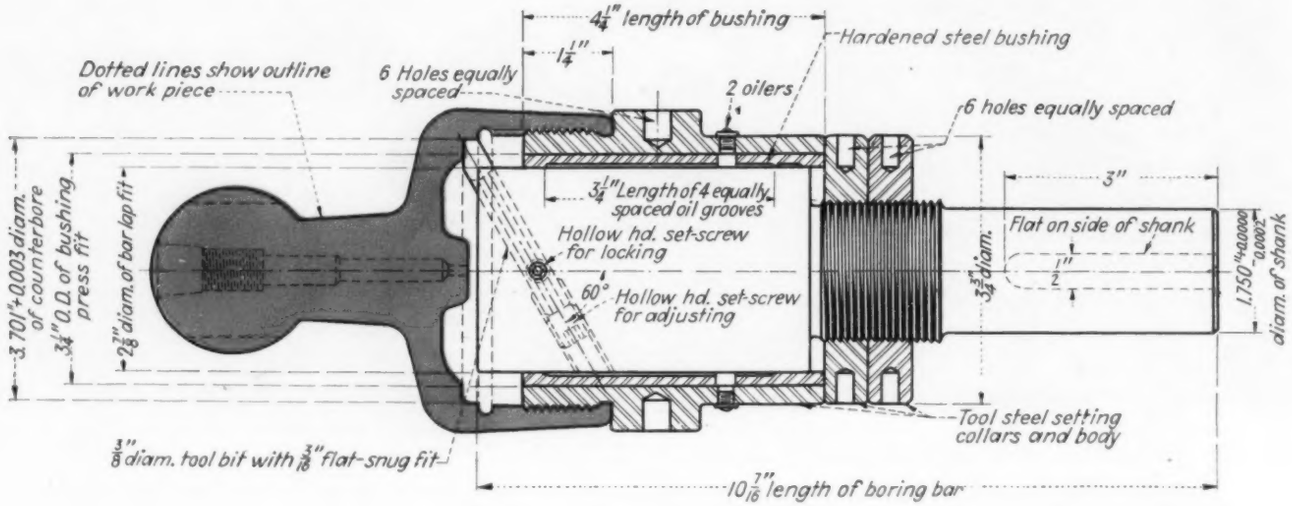
chasers each time with the ratchet device incorporated in the tap body. A similar tap, held in the No. 6 position on the hexagon turret, is used for finish tapping these threads in one or two passes. The Ordnance Department requirements for smooth, perfectly formed threads make necessary the extra passes of both the roughing and the finishing tap.

Final operation is the finish boring of surface *G* and *E* with a high-speed steel tool bit held in the special guide bushing shown in Fig. 9. This toolholder is mounted at position No. 5 on the hexagon turret, and is arranged to hold the tool bit concentric with the tapped threads in the base cap. The guide bushing revolves with the work piece while the boring bar remains stationary in the turret head. The spacing collars govern the depth to which the tool bit is fed once the body of the guide bushing is threaded into the work piece. In this tool a hardened steel bushing with oil grooves is fitted into the body to provide a bearing for the boring bar.

### Spindle Slowed for Tapping

It has been found that a spindle speed of 84 r.p.m. is satisfactory for all of the above operations on the large end of the base cap, except for tapping. Rough tapping is performed at 27 r.p.m., while the finish tapping is done at about 10 r.p.m., the driving clutch being allowed to slip so that a slow speed can be obtained.

After a lot of 40 to 50 base caps have been


4 1/4" length of bushing
1 1/4"
Hardened steel bushing
Dotted lines show outline of work piece
6 Holes equally spaced
2 oilers
6 holes equally spaced
3.701"+.0003 diam. of counterbore
3 1/4" O.D. of bushing press fit
2 7/8" diam. of bar lap fit
3 1/4" Length of 4 equally spaced oil grooves
Hollow hd. set-screw for locking
60°
Hollow hd. set-screw for adjusting
3"
3 1/4" diam.
Flat on side of shank
1"
2
1.750"+.0000 -.0002" diam. of shank
Tool steel setting collars and body
3/8" diam. tool bit with 3/16" flat-snug fit
10 7/16" length of boring bar

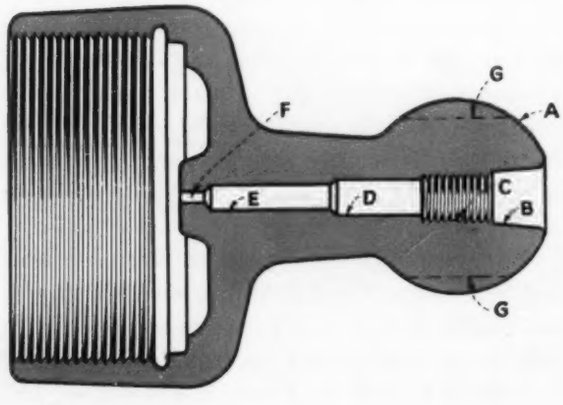



**Fig. 9—Used to keep the threads and counterbore in the base cap concentric, this boring tool incorporates a guide bushing which revolves with the workpiece while the boring bar remains stationary in the turret head**

**Fig. 10—Operations on the ball end of the base cap are performed in a second set-up of the No. 1A Warner & Swasey turret lathe. Flats at G are milled in a following operation on a Cincinnati miller**

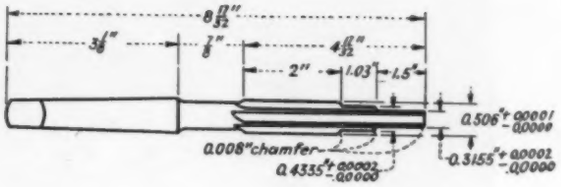
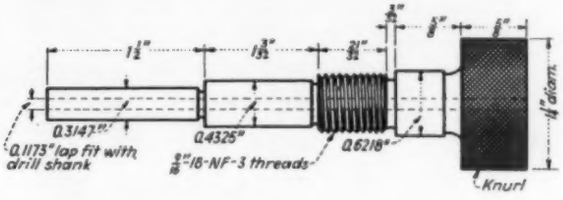


Fig. 11—A three-step reamer with six straight flutes finishes three diameters of the firing pin fit in the base of the cap. It is turned by hand

Fig. 12—A 0.1170 in. drill is used for the final drilling of the hole for the firing pin in the base cap. A special bushing guides the drill in this operation

Fig. 13—Made to fit snugly in the previously drilled, reamed and tapped base cap, this bushing is used as shown in Fig. 12 to guide the 0.1170 in. drill




finished on the large end, the chuck is removed from the turret lathe and a special faceplate having a threaded stud in the center is fitted on the spindle of the lathe. This is accurately centered with an indicator. The stud threads have a close fit with the threaded bore of the cap. A new tooling set-up is made, and then operations on the ball end of the cap are performed, as indicated in Fig. 10.

First, the ball itself is turned with two high-speed steel form tools. Then a hole is started with a center drill, and a larger drill is used to open up hole *B*. Next a two-step drill is used for holes *C* and *D*, and a smaller drill is used for hole *E*. Hole *F* is drilled in a later operation. After drilling, a three-step hand reamer with six straight flutes, as shown in Fig. 11, is used for holes *B*, *C* and *D*. As this forging has a Brinell hardness of 200 to 220, this reaming operation must be done carefully, and the tool must be kept sharp. Next, a pilot tap with Class 3 threads is used for hole *C*. The base cap then is removed from the turret lathe and trucked to a milling machine where flats along the dotted lines *G* in Fig. 10 are milled in one pass.

Drilling of the 0.118 in. diameter hole *F* for the tip of the firing pin is done in a small, sensitive Delta drill press, as shown in Fig. 12. For this operation, a special guide plug

Fig. 14—A special faceplate fixture is employed in this set-up on a No. 5 Warner & Swasey turret lathe for machining forged steel gear cases to close tolerances

Fig. 15—Dimensional and concentricity tolerances on the gear case are very close, and a full set of gages are furnished the operator. The gage shown checks the concentricity of a threaded bore with other surfaces

Fig. 16—This holder is used for finish tapping bronze tension nuts by hand

bushing made as accurately as a plug gage, see Fig. 13, is used to hold the 0.1170 in. drill central. The drill first is inserted in the guide bushing, then the two are placed in the cap and the drill inserted into the chuck. At the start of the drilling operation, the bushing is threaded all the way down into the cap. As the drilling progresses the bushing is slowly returned out of the hole by hand, so as to provide space for chips. The 0.1173 in. hole through the guide bushing is a lap fit with the drill shank, and any attempt to return the drill through this hole with chips would cause the hole to wear. A small quantity of oil is dropped into the cap before the drill and bushing are inserted, so lubrication is provided for the point of the drill.

### Gear Case Operations

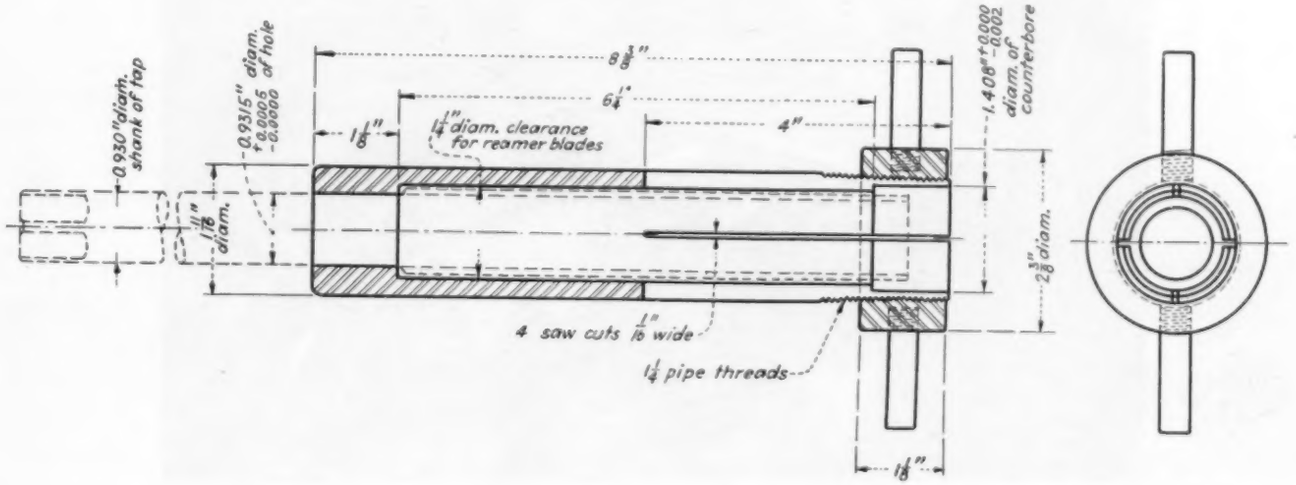
Made from a solid steel forging which is roughed out by a sub-contractor, the gear case is completely machined in a No. 5 Warner & Swasey turret lathe, single-point tools being used for most boring and chamfering operations. A special fixture is used on the faceplate, so that the gear case can be held in three positions for the necessary operations. The set-up is shown in Fig. 14. Diametrical tolerances are 0.0007 in., and the two axes must be kept within 0.002 in. from counterbored faces. Seats for the bevel gears must be within 0.001 in. of these faces.

Dial indicators are used for setting the carriage and cross slide so that the diameters and depth of facing cuts may be held within close limits. A Landis collapsible tap and a solid hand tap are employed in this set-up, both being guided by pilots in previously bored holes. Multi-diameter boring tools are used. Each time the Landis tap is set up in the hexagon turret it is indicated to keep it in alignment with the spindle.

### Wear-Resisting Gages Used

Fig. 15 shows the turret lathe operator inspecting one of the gear case fits with a concentricity gage. It has been found necessary to provide a full line of highly accurate gages for the gear case and all other parts for the mortar and mounts, because of the close machining tolerances. Originally, "Stentor" oil-hardening tool steel was used for these gages, but now they are being made of "Hampton" oil-hardening tool steel, also supplied by Carpenter Steel Company, in order that the gages may have higher wear resistance.

One of the other parts which has caused difficulty is the tension nut for the traverse screw. This nut has an outside diameter of 1.404 in. and a width of 0.470 in. It is tapped with a 0.4 in. pitch modified acme thread of 2½ threads per inch. Thus, there is only a little more than a full turn of thread in the nut. The face of the nut must be square with the axis of the thread. After trying to produce the nut in a turret lathe set-up with little success, it has been found necessary to



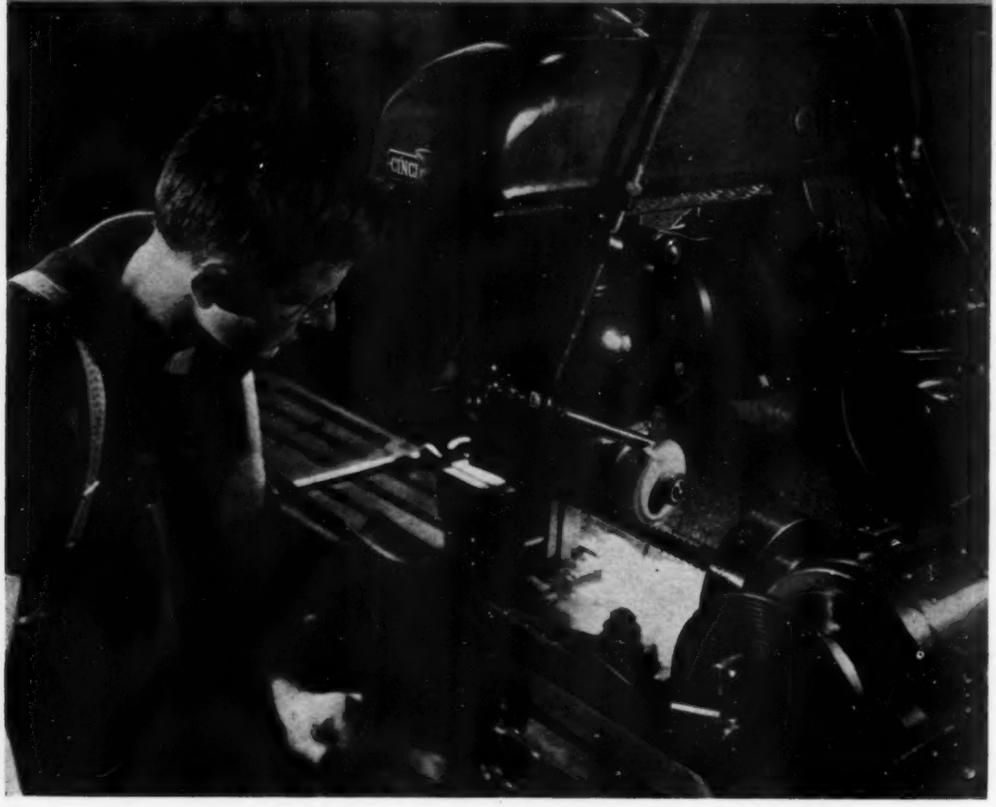
rough the nut out in the turret lathe and then finish the thread with a hand tap guided into the nut by the holder shown in Fig. 16. The threads on the collet of this holder are right hand, so that the increased pressure on the tap tends to hold the work tighter in the collet during the cut.

### High Chromium Screws

Traversing and elevating screws for the mortar mount are machined from a special corrosion resisting steel containing approximately 14 per cent chronium and having a hardness of 200 to 250 Brinell. These screws must be machined in the hard condition, otherwise the corrosion resistance of the steel is lost. The screw stock first is ground on the outside diameter and then the threads are rough chased in an engine lathe. Finally, the threads are finish milled in one pass in the set-up shown in Fig. 17. The modified acme single-pitch thread has a lead of 0.7 in. and the cutter, which is $4\frac{1}{2}$ in. diameter, is rotated at 142 r.p.m. with a table feed of $3\frac{5}{8}$ in. per min. No difficulty has been experienced in holding the required tolerances on these screws, as the Cincinnati miller is in good condition, and the set-up is kept rigid.

The assembly operation on these mortars and mounts which has been the most difficult to solve is that of fitting the base caps to the gun barrels. Since there must be a gas-tight seal at the end of the barrel, it has been found necessary to scrape the cap surface which mates with the end of the barrel. This involves considerable hand work, but has resulted in a satisfactory product.

Fig. 17—Traverse and elevating screws, made from a special corrosion resistant steel, are finished in this thread milling operation after the modified acme threads have been roughed out in an engine lathe



# Lubrication of Ball Bearings—I

*Courtesy of New Departure, Division General Motors Corporation*

Chief duties of a ball bearing lubricant are:

1. To provide a tenuous lubricating film between balls and separator pockets.
2. To dissipate heat caused by deformation of load-carrying members, and separator.
3. To prevent rust or corrosion of the bearing parts.
4. To aid in protecting the bearing against dirt, water, acid fumes or foreign matter of any kind.

Either oil or grease may be used for ball bearing lubrication, the choice depending upon the type and design of equipment to which the bearings are applied. Grease, being a mixture of soap and oil, ordinarily needs only the simplest closures to prevent lubricant leakage and requires the minimum of attention for replenishment. Oil is the most efficient bearing lubricant, but elaborate oiling devices and bearing closures frequently are necessary. Oil lubrication becomes desirable with high operating speeds; subnormal or abnormal temperatures; and when installations involve a single lubricant for the bearings and other mechanical parts.

Grease generally is used for ball bearings operating at normal temperatures, where even a slight leakage of the lubricant must be prevented without the use of elaborate seals. It has the advantage of offering maximum protection against the entrance of foreign materials into the bearings. Grease cleanliness is important. It should be as free from foreign matter as any high grade filtered oil, and should contain no adulterants or fillers. In general, the grease should be of a smooth texture, not fibrous; and it should channel readily, thus offering minimum fluid frictional losses. It should have minimum tendency to aerate or leak past closures.

Table I gives general specifications of greases for various operating speeds and temperatures, consideration being given to the possible presence of excessive moisture. Pure sodium base grease meets the greatest variety of speed and temperature conditions. A small percentage of calcium soap may be added to improve texture. An advantage of this grease lies in the fact that under churning action or at high temperatures, oil and soap separation is at a minimum.

Sodium soap greases are water soluble and should not be used in the presence of excessive moisture. Under such conditions, calcium base greases are desirable. Under churning action or at high temperatures, calcium base greases are at a disadvantage in that their water content evaporates, causing complete separation of the soap and oil, resulting in hard deposits being left on the bearing load carrying members. Aluminum soap greases, while they do not tend to separate easily, have, in general too low a melting point to be suitable for ball bearing lubrication.

### Oils for Ball Bearings

Since the pressure between the balls and separator is light, lubrication requirements are much less critical than with plain bearings at equivalent loads and speeds. Any combination of oil volume and viscosity which comes within the limits of complete fluid films on the bearing parts and full fluid lubrication in such quantity as will not cause excessive overheating of the bearing, will permit the bearing to attain its full rated life, assuming of course that abrasive and corrosive materials are absent. The accompanying chart indicates the viscosity of oil most suitable

**Table I—GREASE SPECIFICATIONS FOR BALL BEARINGS**

| * SPEED R.P.M. | *Bearing Series and Bore Sizes* | | OPERATING TEMPERATURES † | | |
|---|---|---|---|---|---|
| | | | *Moisture Present* | | *No Moisture* |
| | *Light* | *Medium* | 32 to 85 F. | 85 to 150 F. | 32 to 200 F. |
| Up to 500 | Up to 22-mm. bore inc. | Up to 22-mm. bore inc. | Calcium No. 2 cup | Calcium No. 2 cup | Sodium 17–20% soap 300–500 seconds viscosity oil |
| 500 to 2000 | Up to 18-mm. bore inc. | Up to 16-mm. bore inc. | Calcium No. 2 cup | Calcium No. 3 cup | |
| 2000 to 5000 | Up to 10-mm. bore inc. | Up to 9-mm. bore inc. | Calcium Base Grease Not Recommended | | |
| 5000 to 10000 | Up to 6-mm. bore inc. | Up to 5-mm. bore inc. | | | Sodium 30–35% soap 200 seconds viscosity oil |
| ** Above 10000 | Up to 4-mm. bore inc. | Up to 3-mm. bore inc. | | | |

† Below 32° and above 200° F., consult the bearing manufacturer.
* Limiting bearing speed based on ball surface speed of approximately 3000 feet per minute.
** It is recommended that high speed applications, particularly above 15,000 R.P.M., be referred to the bearing manufacturer.

**Table II—OIL VISCOSITIES FOR VARIOUS TEMPERATURE RANGES**

| Operating Temperature Range | SPEED FACTOR (Bore in mm. × r.p.m.) | | | | |
|---|---|---|---|---|---|
| | 15,000 | 75,000 | 150,000 | 300,000 | 450,000 |
| –50 to 125 F. | *95 @ 100 F. | *95 @ 100 F. | *95 @ 100 F. | *95 @ 100 F. | *95 @ 100 F. |
| 0 to 125 F. | *95 @ 100 F. | *95 @ 100 F. | 60 @ 100 F. | 60 @ 100 F. | 60 @ 100 F. |
| 32 to 150 F. | 150 @ 100 F. | 150 @ 100 F. | 100 @ 100 F. | 70 @ 100 F. | 70 @ 100 F. |
| 150 to 200 F. | 600 @ 100 F. | 600 @ 100 F. | 300 @ 100 F. | 200 @ 100 F. | 150 @ 100 F. |
| 200 to 250 F. | 150 @ 210 F. | 150 @ 210 F. | 90 @ 210 F. | 600 @ 100 F. | 400 @ 100 F. |

* An oil having a Viscosity Index of 150 is recommended, otherwise use 60 second oil with Viscosity Index of 100.

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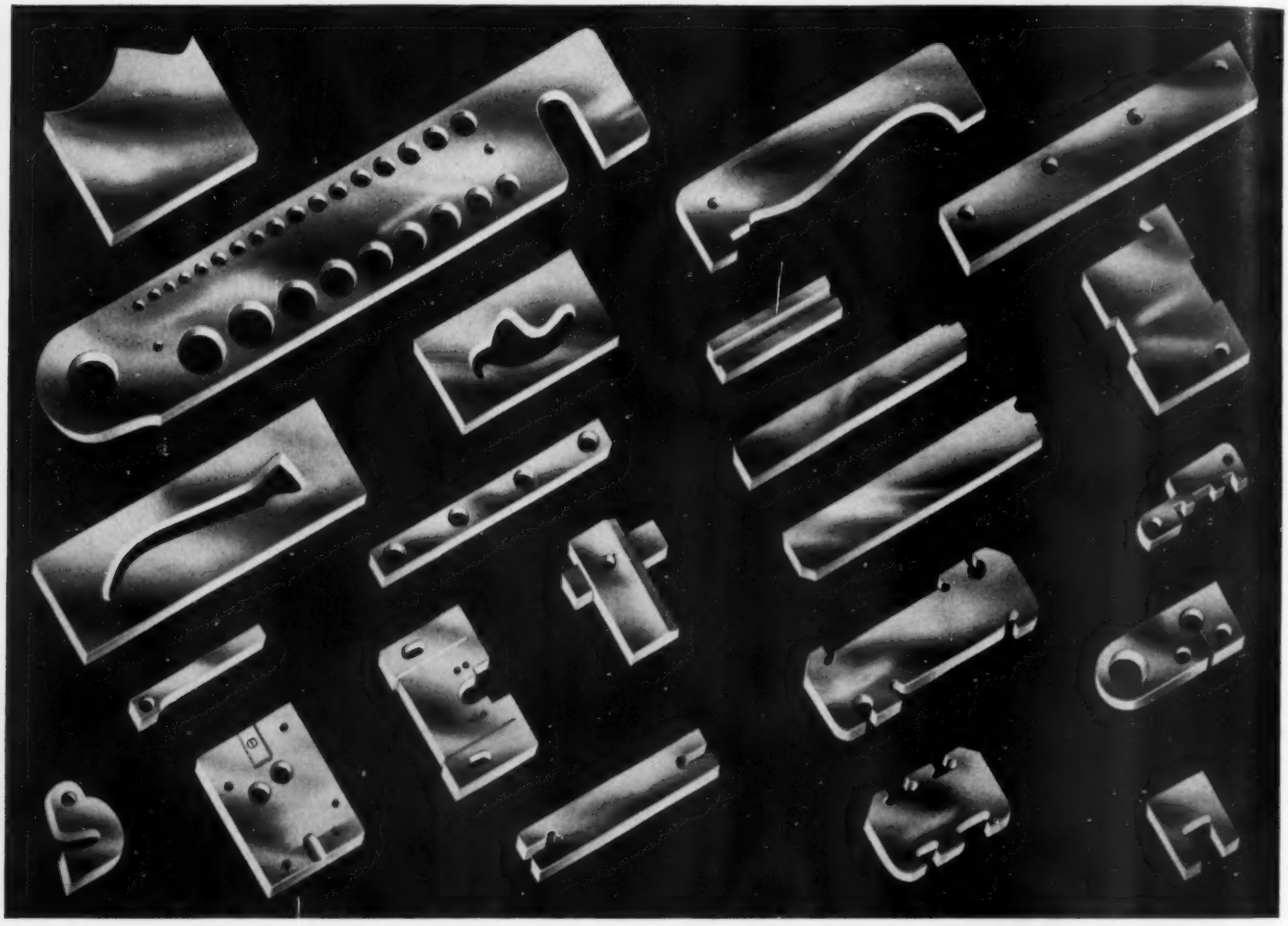

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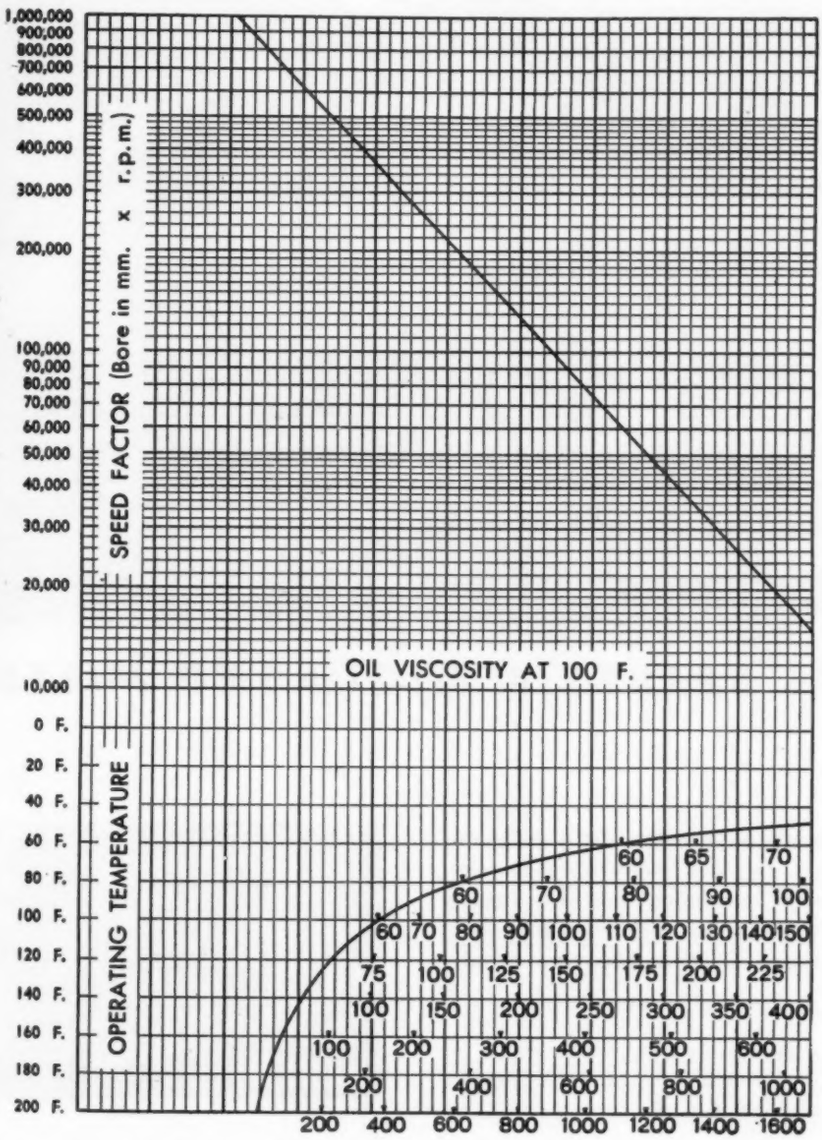
# Lubrication of Ball Bearings—II

for various size bearings running at various speeds and temperatures.

Using this chart, to find the proper viscosity oil to use for any given set of conditions, first determine the "speed factor" by multiplying the bore dimension in millimeters by the speed in revolutions per minute. Find this value on the chart and follow the horizontal line opposite this value to the straight line drawn diagonally on the upper chart. From the point where the horizontal line intersects the diagonal line, descend vertically to the horizontal line representing the operating temperature of the bearing and read the proper oil viscosity. For points which fall outside the curve on the lower chart, a spindle oil having a Saybolt viscosity of 60 seconds at 100 F. is recommended.



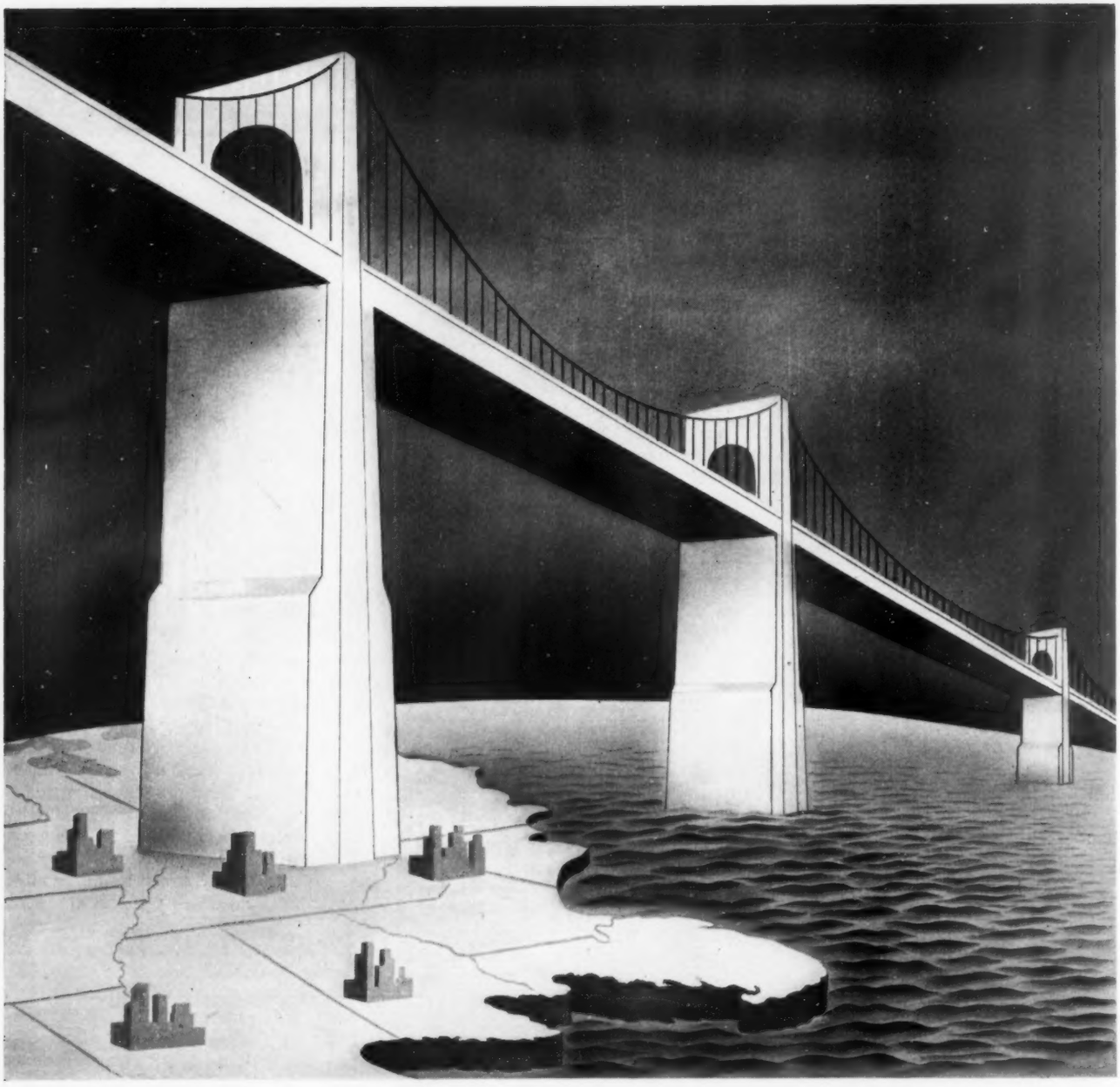

*Recommended oil viscosities for different size ball bearings used at various speeds and operating temperatures can be read from this chart*

*Example:* To determine the proper viscosity oil for a 20-mm. bore bearing operating at 10,000 r.p.m. and 160 F., multiply 20 × 10,000, which gives a speed factor of 200,000. Reading across from 200,000 to the diagonal line and then down to the horizontal line marked 160 F., it will be found that an oil having a Saybolt viscosity of 250 sec. at 100 F. is recommended.

The oils used should be highly refined petroleum oils, such as spindle oils, turbine oils or motor oils, and should have a cold test or pour test lower than the minimum operating temperature. In some applications, bearings operate over a considerable range of temperatures, and it is necessary to choose an oil which will cover the range as effectively as possible. For such cases, oils having a high viscosity index are desirable, since their viscosity is not affected as much by temperature changes as are the low viscosity index oils. In Table II are shown the oil viscosities recommended for various speed factors and temperature ranges.

The method by which an oil should be applied to a ball bearing depends to a large extent upon the surface speed of the balls, for it is in the separator pockets that lubrication is most important as speeds increase. Ball speed is a better index of the lubricating method required than shaft speed. For example, a certain bearing mounted on a shaft operating at 2,500 r.p.m. might be lubricated by oil splash, while a *larger* bearing in the same machine, also rotating at approximately 2,500 r.p.m. might, through the increased ball speed, create such fluid friction in the bearing as to cause overheating and would, therefore, require another method of supplying oil.

Where ball speeds are low, the quantity of oil present is of comparatively little importance, provided there is enough, since over-lubrication at such speeds is not likely to cause any serious temperature rise. However, as speeds increase, fluid friction due to churning must be avoided by reducing of lubricant until, at very high speeds, only a mist of oil is desirable. In order to prevent accumulation of oil, which would cause a rapid rise in temperature, it is necessary that adequate drainage of oil from the bearing housing be provided.



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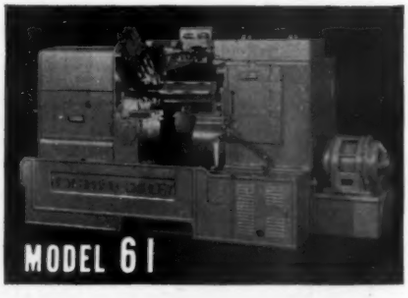



# NEW BRITAIN AUTOMATICS STAY ON THE JOB

# Industrial Blitzkrieg

BRITAIN'S position was never so critical as now. It is up to us as a nation to make good on our promises of abundant aid, unless we are ready to see England and the Empire fall.

But we haven't time to fool around. The Axis powers mean business, war business. They know that today they have their supreme chance to deliver a mortal blow to their enemies before our lumbering war machine gets into action.

Our chief job is to demonstrate that our war machine is not so lumbering and so creaking as Berlin thinks it is. The only kind of demonstration which will impress the Axis is one of speed.

The term blitzkrieg has been applied to a swift and crushing military movement by the Germans which sweeps everything from its path and goes forward at a breakneck rate. It worked in Poland, Denmark, Norway, the Low Countries and France. It appears to be doing well in the Balkans.

Our best hope of stopping Germany's military blitzkriegs is to carry out an industrial blitzkrieg of our own. For Germany's military successes are based on mechanized equipment not possessed by its opponents.

Britain is in dire need of the equipment to be supplied her under the Lend-Lease Act. The next hundred days, as John D. Biggers of OPM has said, may bring the fateful decision of her capitulation or ability to carry on.

No time must be lost in manufacturing the things which Britain must have. Build new facilities here? Yes, wherever it must be done. And if the war is to be won eventually for the democracies, great new arsenals will be required.

Install new machine tools and equipment? Yes, because we must have the highest volume of mass production. But we shouldn't stand around and wait. We can be doing plenty meanwhile.

What's in the way of getting a good start by using to the utmost what we have at hand? What's to prevent our plants from running a greater number of hours than most of them have been operating? The answer is, "Nothing!"

The true facts today are very revealing. Many factories are doing their share and more by working long hours and extra shifts and by subcontracting work. But you'd be surprised at the number of companies which are still on single shifts. And you'd get a still bigger shock if you could see the list of companies which are doing no defense work at all.

Washington officials have set out anew to increase our defense efforts. They are asking metal-working plants to run at least 120 hours a week. That amounts to three 40-hour shifts or two 60-hour shifts. More companies are on two shifts than three, partly because extra men are hard to get and partly because employees like the overtime pay. A 60-hour week would mean ten hours a day six days a week. More and more companies are coming to a schedule like that.

Subcontracting has a long way to go before it takes in all the firms which should be doing defense work. Its greatest asset is that it makes maximum use of older equipment already on plant floors.

The benefits of such use are four-fold, according to George T. Trundle, Jr., president of the Trundle Engineering Company. It helps lighten the load on machine tool builders today. It lessens the building up of excess plant capacity which will be undesirable after the war. It reduces the sum total of the taxpayers' bill for defense (and we all share in that). It gets production started more quickly.

If we are to keep our promise to Britain and, what is more, protect ourselves, we must carry out an industrial blitzkrieg. We must turn out munitions at a speed which no other nation can match. And that is not an impossible task in the most highly mechanized country in the world.

To quote Mr. Trundle, "Today wars are not won at the front. They are won in factories. Gains are made not in terms of miles advanced; they are made in terms of production increases. The success of this country in national defense rests upon our capacity to speed up production. Production can best be speeded up today by putting into operation every possible existing machine, whether it be five, ten, fifteen, twenty or even thirty years old."

Burnham Finney

# GAGING BUSINESS

**Metal-working plants asked by OPM to go on a schedule of 120 hours a week as a minimum. Lend-Lease demand will throw unprecedented burden on machine tool industry for months ahead**

U. S. metal-working plants are being asked to operate at least 120 hours a week by defense officials to carry the load imposed by Lend-Lease requirements on top of the defense program itself. That is equivalent to two shifts of ten hours each six days a week. Many factories are already on that schedule or are close to it. Still others are running three eight-hour shifts on a six-day week, though difficulty is experienced in securing skilled men for that basis of operations. OPM has inaugurated a new drive to put to work hundreds of companies which as yet do not have defense subcontracts.

**Machine Tools**—The machine tool industry is about to have the heaviest load in history placed on it, just as it appeared that the pressure of new business was easing a bit. The new program arises out of Britain's needs under the Lend-Lease agreement and will strain the industry's productive facilities, now being further expanded, for months ahead. Moreover, Britain's present critical position has influenced Washington to put on heat to speed manufacture of planes and munitions and the building of ships. That means that the pressure on machine tool builders for deliveries will be intensified. Indications are that just as many machine tools will be required for defense purposes in 1942 as this year, when the industry expects to turn out $750,000,000 of machines, or more than seven times its normal annual output. Deliveries of some types of machine tools cannot be made until the second quarter of next year, though many manufacturers have certain kinds and sizes of machines available for 1941 shipment. A mad scramble continues among defense contractors for good used and reconditioned machine tools which can be put to use immediately. A serious shortage of gages and other measuring instruments probably will be relieved soon when new plants producing those articles get into operation. Small tool demand exceeds the supply.

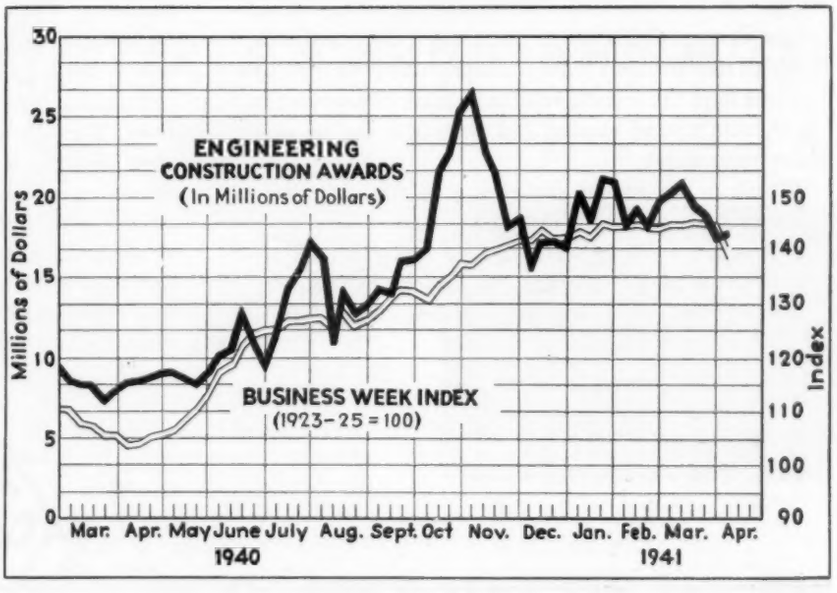
**Shipbuilding**—If the battle of the Atlantic is to be won with merchant ships, some 600 cargo ships a year must be built indefinitely in U. S. yards. That compares with only 200 heretofore planned. No practical program for turning out such large numbers of ships, amounting to some 4,500,000 tons annually, has yet been agreed upon. Negotiations have not been successful with steel fabricators and other companies outside the shipbuilding industry to induce them to construct new yards and take contracts for lots of 25 to 35 ships each. It is reported that opposition in the Maritime Commission to the huge additional merchant ship program has collapsed. Under the Lend-Lease Act $629,000,000 is specifically allocated for "vessels, ships and other watercraft." The new cargo ships will be mostly prefabricated and the power plants will be built outside the ship yards.

**Steel**—The tight situation in steel has been only slightly relieved by suspension of shipments of carbon steel to the British until further notice. One reason for British action is the accumulation of large stocks at docks and the desire to use cargo space for products more urgently needed. The jam in alloy steels has become even greater, and defense officials have clamped down priorities on nickel steel similar to those on aluminum. Steel users have been most cooperative in substituting other alloy steels for nickel steel.

**Railroad Equipment**—With greatly improved earnings and peak carloadings ahead, railroads have completed the best first quarter's equipment buying since 1928. The total is estimated at 320 locomotives, 295 passenger cars and 27,500 freight cars. Equipment expenditures this year are expected to exceed those of 1940 by 20 per cent. Illinois Central has ordered freight cars costing $7,000,000 from General American, Pullman and American Car & Foundry. New York Central will build 1,000 box cars in the shops of its subsidiary, Merchants' Despatch, Inc.

**Aircraft**—April production is expected to show an increase over March, during which 1,126 planes were assembled compared with 972 in February. Biggest expansion has been in fighting planes. Engine manufacture is keeping much closer pace with plane output than a few months ago. Since Jan. 1 the industry has enlarged its productive facilities 28 per cent.

**Munitions**—Small arms production is ahead of schedule, but pressure is being exerted in Washington to get three huge new plants into operation next fall instead of in the spring of 1942. Machine gun manufacture is being maintained close to the quota set, and so are explosives. Preparation for medium tank production has been deliberately held up to give preference to more critical items. Some 26-ton tanks, nevertheless, will be made this month or next. In the last seven months 784 new factories for munitions production (including aircraft) have been started and are 60 per cent completed. Included in Lend-Lease appropriations are $1,343,000,000 for ordnance and ordnance stores, $362,000,000 for tanks, armored cars, automobiles, trucks and other automotive vehicles, and $260,000,000 for miscellaneous military equipment. Allis-Chalmers has begun 24-hour operations six days a week to catch up with its defense schedules. International Harvester and Pullman have received sizable shell orders. The War Department has awarded contracts for cartridge cases to Ingersoll Steel & Disc Division of Borg-Warner for $7,960,500 and to Guide Lamp Division of General motors for $4,872,900.



# Wave of Strikes Receding; National Steel Wage Boost May Influence Other Disputes

NEW YORK—There were signs last week to indicate that the wave of strikes was receding from its high water mark of March and that less troubled seas may lie ahead.

Biggest single optimistic note came from the steel industry where, for weeks, a strike against the U. S. Steel Corp. had been threatened by C.I.O.'s Steel Workers' Organizing Committee. The issue was wages with U. S. Steel offering a two and one-half cents an hour pay boost while the union demanded 10 cents. Negotiations had reached an impasse and a strike call was imminent when Ernest T. Weir, president of the National Steel Co., announced a ten-cent an hour raise for his 21,000 employees. His announcement broke the log jam that had tied up the SWOC meetings with Big Steel in Pittsburgh; for there was little doubt that U. S. Steel Corp. would follow suit.

As a matter of fact the Weir announcement may well have profound repercussions throughout all industry. C.I.O. unions have, for the most part, been waiting on the outcome of the steel negotiations before formulating wage demands. If steel had settled on a five cents an hour increase that could have been taken as the pattern which other unions would follow. Now, ten cents is what they will all be pitching for.

### Settle Allis-Chalmers Strike

Another reason to believe that the troubled labor sky was clearing was the settlement of the 76-day old Allis-Chalmers strike. In finding a formula for the resumption of operations after having the case only two days, the National Defense Mediation Board earned prestige which will serve it well in handling other difficult disputes. The issue in the Allis-Chalmers strike, a union demand for an un-named closed shop, had put a serious brake on defense production by tieing up $45,000,000 in defense orders. NDMB's accepted proposal does not give the union a closed shop, but has satisfied strikers that their union will be protected.

When the President named 11 alternate members to serve on NDMB in the event that his original appointees had to absent themselves on private business, it was an acknowledgement of the new Board's important role. It leads to the conclusion that NDMB will be in more and more situations as time goes on; soon, perhaps, supplanting the U. S. Conciliation Service as the nation's No. 1 labor peacemaking body.

Most dramatic strike on the industrial front is the dispute which closed down the vast River Rouge plant of Ford Motor Co. and the effect of which has been to shut down all domestic Ford operations. Although the immediate cause of the strike was the union (United Automobile Workers-C.I.O.) allegation that eight members had been fired without just cause, a charge vigorously denied by the company, the issues are fundamental.

Ford runs the last non-union shop in the auto industry and the union has regarded it as their prime objective for years. The Ford policy, not to deal with an outside union, is considered by the C.I.O. a threat to its existence. Basic to the strike is the question of whether Ford will deal with the C.I.O. After a week of the strike it looked like a case of the irresistable force meeting the immovable object. Nevertheless, with Ford facilities urgently needed for defense production, government pressure on the company to reach an agreement with the C.I.O. will be tremendous and perhaps decisive. Expert observers gave Ford little chance to escape the kind of adjustment to unionization which General Motors and Chrysler have had to make.

Bituminous coal production was also stopped as the United Mine Workers Union, John L. Lewis's organization, wrangled with the coal operators over the question of eliminating the 40 cents a day wage differential that exists between the Northern and Southern mines. With coal stocks dwindling the dispute was becoming serious, but a settlement was expected before a grave coal shortage resulted.

### AGAINST STRIKE LEGISLATION

WASHINGTON—Labor Secretary Perkins and OPM Director Knudsen expressed opposition last week to legislation designed to curb strikes on the ground that the picture was fast clearing and the expected cooperation seems to assure the success of the defense program. Knudsen, however, indicated to the House Military Affairs Committee investigating the efficiency of the program, that the Selective Service Act should be amended to provide that plants which "fail" to deliver on their defense contracts be made subject to government seizure and operation.

## Almost 12 Billion Spent In U. S. Contract Awards

WASHINGTON—Contract awards of the Army and Navy in the national defense program totaled $11,884,000,000 as of March 8, according to a compilation made by the Bureau of Research and Statistics, Office of Production Management. At that date the Army and Navy program authorized by Congress totaled $16,384,000,000. Contract awards covered 72.6 per cent of the program. This includes contract authorizations for completion of orders in 1942 and later in case of warships.

Army contract awards as of this date totaled $5,900,500,000 against an authorized program of $7,098,000,000. Contracts covered 83.1 per cent of this program. Navy awards totaled $5,983,500,000 against a program of $9,266,000,000. Contracts covered 64.6 per cent.

**More Men for Defense**—*At Delehanty's Institute, New York, N. Y., 1,200 students are being trained in machine shop practice. Day and evening classes include such courses as: lathe work, screw machine and turret lathe operation, miller and surface grinding work. The institute offers up to 300 hours of work in each course*

# Distribution of Commodities with Priority Ratings is Proving A Complex Problem

WASHINGTON—When the priority system was instituted its purpose was to see that defense contractors placed munitions work ahead of their regular work. This, still the prime purpose, is largely handled through the automatic system administered by the Munitions Board. As the armament program has increased the more complex problem of distribution control of the entire output of certain industries has become more important. A mechanism created for this purpose has become more definite during the past month.

Now subject to control is the entire distribution of machine tools, aluminum, magnesium, neoprene (artificial rubber), and tungsten compounds. In most of these cases it has simply been necessary to issue the sweeping but comparatively simple order that deliveries be made only in accordance with priority ratings.

More complex is the situation when defense uses absorb a major part but not all of the output, and the remaining supply must be allocated among non-defense users. This problem will become more common as priority control is extended to a wider range of basic materials, but it has already been encountered in the case of aluminum. The procedure evolved for this metal is establishing the pattern which will be followed in a general way on other materials.

### Special Rating for Aluminum

The rule of course is that orders with priority ratings must be filled first. To cover the case of obvious defense orders which do not have ratings, the aluminum producers are allowed to attach a rating of A-10 to such orders; this puts them ahead of all civilian orders but behind priority rated orders.

To ensure compliance with this rule and to permit regular readjustments of the ratings on particular orders, the aluminum producers must submit their order books monthly with a schedule of the orders they propose to fill.

Last month, defense orders absorbed about all the available aluminum, but this month, and in the future, a limited supply is available for civil uses. To aid in rationing this, a series of B priority ratings has been defined by the Priorities Division under which civil orders are graded from B-1 to B-3 in accordance with their social importance. Ratings are applied to orders jointly by OPM and the aluminum producers and fabricators. Identical ratings apply to nickel steel.

The highest civilian rating, B-1, is for emergency needs. The producers are required to set aside 1 per cent of their production in a pool from which OPM will fill B-1 orders.

B-2 rating applies to orders for aluminum to repair or replace essential apparatus. Likely examples are replacements for commercial airlines and power companies. Orders with this rating are tentatively scheduled to get 80 per cent of the customers average monthly deliveries in 1940. This percentage, and those mentioned below, are subject to change monthly.

The B-3 rating is for aluminum products essential to public health and safety such as packages for drugs. These will receive 70 per cent of last year's supply.

Aluminum orders for standard apparatus which cannot be redesigned to get along without it and for which there is substantial use in defense get the B-4 rating and 60 per cent of last year's deliveries.

Small customers using less than 1,000 lb. a month get a B-5 rating entitling them to 50 per cent of last year's deliveries.

Apparently the auto industry receives the B-6 rating, which covers articles in which not more than two pounds of aluminum per $100 of final sales value is used. Such orders get 40 per cent of 1940 deliveries.

The B-7 and B-8 rating cover articles not otherwise classified for which there is a satisfactory substitute. B-7 orders get 30 per cent and B-8 orders 10 per cent of normal deliveries. In the lower group are the kitchen utensil people and the bus manufacturers, several of whom are already completely redesigning their line to eliminate the aluminum.

The free market in aluminum scrap is completely eliminated by application to secondary smelters of the same controls hitherto applied to primary producers and fabricators. Moreover, secondary smelters are forbidden to do toll-smelting for private customers without specific permission from OPM.

## LEND-LEASE BREAKDOWN

WASHINGTON—The seven billion dollar appropriation incorporated in the lend-lease act will be used for the following:

| *Commodity* | *Amount in millions of dollars* |
|---|---|
| Ordnance and stores... | $1,343 |
| Aircraft and material. | 2,054 |
| Tanks and automotive vehicles ..... | 362 |
| Ships and watercraft.. | 629 |
| Miscellaneous military equipment ..... | 260 |
| Facilities for production of defense articles... | 752 |
| Agricultural and industrial commodities ... | 1,350 |
| Testing and repairing any defense articles for U. S. or other countries vital to its defense ..... | 200 |
| Miscellaneous ..... | 50 |
| Total ..... | $7,000 |

The law allows the President to transfer 20 per cent of any appropriation to any other appropriation, but no appropriation may be increased by more than 30 per cent.

## Warns Against Coercive Soliciting of Advertising

WASHINGTON—The U. S. War Department has issued a warning against "coercive methods used to solicit advertising from firms holding government contracts". This announcement came as a result of a complaint of a manufacturer who indicated that a periodical with offices in a southwestern city had solicited its advertising through a letter creating an impression of military connections which were imaginary.

**Tanks For U. S. Army**—*Major General Charles M. Wesson, Chief of Ordnance, is in the turret of a new Medium Tank, M3, which was being demonstrated at Aberdeen Proving Ground, Md. last week*

## *Cimatool Co. and Sheffield Gage Corp. in Merger*

*Louis Poock (left) has been elected president and general manager and O. M. Poock has been elected chairman of the board, The Sheffield Corp., Dayton, Ohio, formed by the merger of the Cimatool Co. and the Sheffield Gage Co. O. M. Poock was president, Cimatool Co., while Louis Poock was general manager of both former companies. C. H. Reynolds, formerly president, Sheffield Gage Corp., has been elected vice-president of the new concern. Sheffield will continue production of the same products*

# Increase Government Action to Conserve Raw Materials; Activity Coordinated by OPM

WASHINGTON—Governmental action to conserve the supply of scarce raw materials and promote the use of substitutes is increasing. These activities are being pulled together by a conservation unit in the Office of Production Management and headed by Robert E. McConnell, a mining engineer and president of a number of development and investment firms.

In the development of substitutes, the unit is relying heavily on technical advice from the Bureau of Standards and the National Academy of Sciences. A number of specific research problems have been assigned to the Academy in this field. The conservation unit is calling conferences with groups of manufacturers to work out voluntary measures for conservation of strategic materials, in some cases for immediate application and in other cases to have ready if needed. It is also working with merchandisers to promote the sale of articles made from plentiful materials. As a last resort it is prepared to make public appeals to consumers to avoid purchase of certain articles, such as Defense Commissioner Harriet Elliott's appeal to women not to buy aluminumware. Waste material dealers have been asked to form committees to promote through reclaiming of important materials.

Action now underway includes:

**Plastics** — Priorities Administrator Stettinius has urged manufacturers to study the possibility of substituting plastics for aluminum, magnesium, and zinc. A plastics unit in the Bureau of Standards is ready to give advice on this problem and is itself working on the development of a plastic suitable for use in stressed parts of aircraft. Refrigerator manufacturers, particularly, are working on plastics; one project provides for building complete refrigerator frames of plastics.

**Tin**—A meeting is to be held this month of can manufacturers to determine how much the use of tin cans could be reduced in an emergency, what substitutes are available, and what the repercussions on other industries would be. The Academy of Sciences is studying possible substitutes for tin in cans, collapsible tubes, babbit metal, and solder.

**Nickel**—The Academy recently reported that present shortages are partly due to the building up of inventories and that this demand may soon slacken off somewhat. Uses of the metal are so various that no big simple conservation measures are available.

**Manganese**—The Academy reports that domestic spiegel can be used as a partial substitute for imported ferromanganese in steel making and that ferromanganese requirements could, if necessary, be reduced about 20 per cent by technical changes which would somewhat lower the quality and raise the cost of steel.

**Tungsten**—Tool steel firms have been urged to substitute molybdenum and other alloys for tungsten steel wherever the highest quality is not essential. Alleghany Ludlum Steel Corp. has released its patented tool steel formula, which uses only 5 per cent tungsten, for general use without payment of royalty.

## STEEL OUTPUT AT PEAK

NEW YORK—Steel production in March set a new high record of 7,146,372 net tons, or 203,000 tons more than in the previous best month, January, and 63 per cent above the production figure of 4,390,090 net tons in March last year. This is indicated in a report last week by the American Iron and Steel Institute. At this rate the output was equal to 100 per cent of rated capacity, the first time the steel industry, as a whole, has attained this rate since May, 1929, when operations exceeded par for the first time since the World War. Tonnage capacity was, however, much lower in 1929 than now. March output was at a weekly rate of 1,613,177 net tons, compared with 1,562,603 net tons in February, and 1,567,288 tons weekly in January.

## Wright Trains Huge Number Of Aircraft Engine Workers

NEW YORK—Wright Aeronautical Corp., which is now rushing to completion a mammoth 50-acre factory at Cincinnati, Ohio, has organized the largest training program for aircraft engine workers in the U. S. One thousand workers have already been placed on the payroll; 14,000 are needed for the scheduled maximum production of 1,000 engines monthly.

After a survey was made of training facilities in the Cincinnati area, instructors and machines were sent on from the company's plants in Paterson, N. J. and the entire program set up. Company operated training schools, which are the backbone of the program, are supplemented with courses for engine assembly and testing at local high schools, vocational schools and night classes at the University of Cincinnati.

Trainees are given psychological tests to determine intelligence and adaptability. Then they are taught shop arithmetic, science, the reading of operating sheets and use of measuring tools for a week. With the most incompetent trainees weeded out at the start, the remainder are drilled for three weeks by Wright instructors. Later the trainee works beside a skilled operator for a period until he is capable to go on his own.

The training of inspectors is an exception to this routine. To train inspectors, some of the men completing the four weeks regular training are given an additional two weeks of training in inspection technique and routine paper work. There are 50,000 separate and critical inspections during the manufacture of a Wright Cyclone engine. At present there are 1,078 inspectors employed by the company.

# SMALL PLANTS NEED HELP IN SUBCONTRACTING

Local commerce associations valuable in securing subcontracts for many small plants. Federal Clearing House also aids in the work

NEW YORK—Small plants in the U. S. which are looking for subcontracts are at present being left pretty much to their own devices despite the fact that local commerce associations are doing everything possible to help. However hundreds of plants have established temporary subcontract sources and others are developing these sources rapidly. In some sections of the country, notably Philadelphia, the establishment of subcontract clearing houses in Federal Reserve Banks is making considerable headway. But despite the extensive groundwork, much remains to be done to make the Federal Reserve clearing house system workable and useful to the manufacturers who need this service most. These are the conclusions of a survey on subcontracting completed by the AMERICAN MACHINIST last week.

A graphic picture of metal-working subcontract activity by states follows:

**New York**—The State Defense Council has called on the Division of State Planning to conduct a survey of all metal-working facilities in the state. This is the initial step; more assistance will be given to prime contractors. Brooklyn's Chamber of Commerce maintains an inventory to show idle plants. Subcontract work now involves $50,000,000. In New York City the Merchants' Association has surveyed capacity of small machine shops and about 32 shops have indicated an interest in subcontract work. In Middletown, Rome, Schenectady, Batavia, and Oswego the respective Chambers of Commerce have data regarding idle plant capacity.

**Pennsylvania**—The State Department of Commerce has aided the formation of 36 regional production pools to handle subcontracts. These are designed so that plants may share orders within local regions without causing needless expansion of industry and migration of workers. A running inventory of available tools and companies seeking subcontracts is maintained.

**Connecticut**—A list of all important manufacturing concerns in the state, listing what each is prepared to make, has been prepared by the State Development Commission. A current index of manufacturing activity has been instituted to develop idle machine hours classified by types of equipment and the existence of machine, labor, or material bottlenecks or surpluses and a 60-day forecast of activities applied there. When idle capacity is discovered the index will indicate the ability and willingness of manufacturers to accept contract work.

**New Hampshire**—Chamber of Commerce committees are studying idle plant capacities and a limited possibility of handling additional work is indicated.

**New Jersey**—The New Jersey Manufacturers Association is cooperating with Federal Reserve Banks in Philadelphia and New York. Few shops are available for additional subcontract work.

**Delaware**—A survey of production facilities has been carried through by the Wilmington Chamber of Commerce and results are now being tabulated.

**Massachusetts** — Chamber of Commerce committees are handling data about prime contracts in the cities of Chelsea, Newton, and Lawrence, with the aim of assisting in the farming out of work to factories that are properly equipped.

**Maryland**—The Industrial Bureau of Baltimore has been cooperating with the N.A.M. plant survey recently. However it has been aiding subcontractors over a period of weeks.

**Ohio**—A survey by the Canton Chamber of Commerce has revealed a surprising amount of capacity and a number of smaller concerns not doing any defense work. In Cleveland, Federal Reserve Bank officials are taking over the clearing of subcontracts. No plant surveys have been made. At Columbus a continuing study of idle capacity is maintained by the Chamber of Commerce.

**Michigan**—A defense committee of the Automotive Tool & Die Manufacturers Association maintains a continuous survey of idle capacity in cooperating shops. The Federal Reserve District branch is beginning to take over subcontracting responsibilities.

**Minnesota**—Subcontract activity is being directed by the Defense Contract Service in the Federal Reserve Bank.

**Missouri**—The Mid-Central War Resources Board has been operated in western Missouri and Kansas since last July to coordinate resources in this area in over 125 cities. Surveys indicate that considerable idle capacity is available.

Surplus capacity is available in Des Moines, Iowa; little is available in Indiana; in Wisconsin a State Defense Council has been established to survey idle capacity. In Virginia the Richmond Chamber of Commerce has been cooperating with federal officials in surveying plant facilities.

# Canada Emphasizes Shipbuilding in Present War Efforts; Delay Due to Labor Shortage

MONTREAL—The emphasis in Canada's present war effort is on shipbuilding with the program falling into two parts: 1) full speed ahead in the construction of some 20 cargo boats on which work has already begun, and 2) preparation for the construction of more cargo boats, larger warships.

To expedite the first phase of the program, H. R. MacMillan a west coast industrialist, has been appointed to head a new government-owned company, Wartime Merchant Shipping, Ltd. At the same time orders have been placed for 20 10,000-ton boats; because of the lack of labor Canada cannot do much more this year. Some shipyards have not been able to attain 24-hour activity for the same reason. Criticism in Parliament resulted in the appointment of MacMillan who has the power to call on tool makers, steel plants, transportation companies and others for every cooperation.

Although Canada has expanded her shipyards rapidly, she has had to start from scratch for when the war started she had only a half dozen active shipyards, only three or four which could build boats of any size. Employment since then has jumped from 1,500 to 20,000 men.

For the longer term Canada has aimed at an ambitious program. Bids have been asked on four 700-ton cargo ships, but no contracts can be let until the yards are ready to handle more work. Plans are being formulated for the construction of destroyers.

In aircraft an order for 39 flying boats, equipped with twin Pratt & Whitney Wasp engines, has been placed with Canadian Vickers Co., Montreal. Each plane will cost approximately $150,000. Production will begin early in 1942. Negotiations are under way for the construction of Martin bombers in Canada; National Steel Car Corp., whose Malton plant is only partly active, may get a large share of the order. Canadian factories now have an annual output of $130,000,000 and employ 25,000 men; before the war these figures were 1,000 men and an output of $1,000,000.

Recent contracts let by the government are: Aircraft: Canadian Car & Foundry Co., Ltd., Montreal, $3,272,670; Fleet Aircraft Ltd., Fort Erie, Ont., $435,753; and National Steel Car Corp., Malton, Ont., $174,998. Shipbuilding: Greavette Boats Ltd., Gravenhurst, Ont., $170,000; and Yarrows Ltd., Victoria, $1,312,000.

# INSIDE DETROIT

**Ford's tooling up activities on national defense have been brought to an immediate halt as a result of the CIO strike. The company's new car stock will withstand one month's sales before exhaustion**

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Tactics employed by the UAW-CIO to bring the vast Rouge plant of the Ford Motor Co. to a halt show an exquisitely trained finesse in the use of the sitdown, the slowdown and the street barricade. Never before had the company in its 38-year history been brought face to face with such weapons.

Even now it is almost unbelievable that the Ford empire could actually become strikebound. Very few persons here realized the imminently serious character of the work stoppages and mass disturbances that occurred within the Rouge gates for two weeks prior to the actual strike. But the Supreme Court erected a signpost, "Trouble Ahead", when it refused several weeks earlier to review a lower court decision holding that the company must abide by certain orders of the National Labor Relations Board. The fuse was laid then; it remained for the union to bring up the powder bags. Almost immediately, organizing efforts of the union were rewarded in increasing measure, union buttons blossomed like daisies, and the process was begun of knitting together mass strength with which to create incidents.

### Sitdowns Not So Costly

Productionwise, the sitdowns and work stoppages that occurred in the Rouge plant were not so costly as similar occurrences in other automotive plant disorders. About 3000 cars were lost per week but widespread damage was not reported. Yet the disturbances served their chief purpose: (1) to make the management take action against infringement of the rules, and (2) thereby to pave the way for aligning masses of men against the company because of action taken against agitators. Thus it appears that in this case the union strategy was to create incidents quickly, get the men out on the streets and close the plant down (the police power of Michigan had shrunk to 280 state police through induction of the National Guard into the Army), and then through a *fait accompli* to win an early decision by the Labor Board on a representation election. That election must be held by some time in May, which bears out the prediction made previously (*AM*—Vol. 85, page 312*h*).

Up to that point, the union strategy accomplished its purpose but it may be questioned whether its ultimate goal will be attained. The Ford Motor Co. is again fighting for a principle, and the country knows its sticking powers in such matters. A number of days after the strike commenced, the temper of the organization had not improved, according to reliable sources. It was suggested that the plant might not reopen until an election is held, in which case the workers and communities nearby would really be up against it through a wage loss of $900,000 per day. Circumstances might arise whereby the UAW-CIO would win the election and still be faced with a large group of employees bitterly opposed to that union, or even strongly in favor of the AFL.

Heart and soul of the Ford organization is the Rouge works, which is undoubtedly the most highly integrated and diversified manufacturing plant in existence. The largest private foundry in the world and a huge steel and strip mill form the basis for manufacturing much of the Ford product direct from ore. Engines, transmissions and many other mechanical components and body parts are produced for assembly into motor cars at fifteen branch assembly plants throughout the country (relatively few cars are assembled at Dearborn). Operating in conjunction with these basic industries are others such as: glass, tires, plastics, the largest private powerhouse in the world, cement, coke and by-products.

A work stoppage within the gates of the Rouge would eventually ripple out to the farthermost outposts of the company. When the plant closed and 84,000 were made idle, it was only three days before 34 branch assembly plants and manufacturing plants were brought to a standstill either because they could not get materials from the Rouge or could not deliver them. Thus, a working force of 118,000 soon found themselves without employment. Apparently it has never been the policy

### RECORD AUTO SALES SEEN

DETROIT—Auto companies foresee sales during April and May which will be in excess of all time records established in March. Despite peak assembly rates, March production of some major companies was ten per cent under customer deliveries. Parts makers have not been asked to curtail shipments to car factories. Current outlook is that manufacturing operations will continue unabated through June, then drop off sharply with the clean up of 1941 model materials. The industry expects to hear from Washington soon in regard to an arbitrary cut in production of 1942 models, to be applied universally, in order to save steel for merchant ships and armament.

Wide World

**Strike at Ford**—*Michigan State Police stand by at the Ford River Rouge plant, Dearborn, Mich., as members of the United Automobile Workers—CIO picket the plant. The picket line was one-quarter of a mile long*

**Machine Tool Scramble** — *Typical of the keen demand today for used machine tools was the recent auction of machinery at the plant of the Miller Improved Gas Engine Co. at Springfield, Ohio. Buyers came from all over the country and from Canada to purchase equipment some of which was 15 and 20 years old*

of the Ford Co. to accumulate more than four to five days stock at any point. The main exception occurred in the depression when Mr. Ford gave thousands of men work building up a huge engine and parts bank.

Each day an average of 1350 freight cars move into and out of the Rouge plant with materials and parts. Thousands of trucks likewise move goods, and in the ice-free season the Ford fleet of 28 vessels operates. Interruption of this traffic had immediate repercussions upon Ford vendors, of whom between 450–500 possess orders at the present. Ford purchases since Jan. 1 have averaged $11,000,000 per week. While the company notified suppliers to cease shipments on outstanding orders because of the tie-up at the Rouge, Ford specifically did not ask them to cease production. That decision was left to the supplier, who must reach his own conclusion in view of storage facilities and other problems. There are no statistics on the number of outside workers affected by the strike, but it probably equals the number employed by Ford. It is known that thousands were laid off by suppliers in the first few days after the Rouge plant went down.

So far as the Ford customer is concerned, it is believed that the new car field stock is sufficient for almost one month's sales. Supply or replacement parts is not a problem.

By and large the national defense activities of the Ford Co. were brought to a halt by the strike. The exception was the work of engineers who are seeking to manufacture the Consolidated four-engined bomber by the subassembly method, and the reason for this circumstance lies in tne fact that they were not situated in the Rouge plant. All tooling up activities on the aircraft engine plant stopped at once, and of course construction and machinery installation ceased also.

The Ford method is to use any or all of its manifold facilities on defense as the occasion arises. Engineers and toolmakers are not segregated specifically on defense tasks. Any or all of the talent available is put on a job if need be. These men in turn can ask for whatever other facilities are required to get the work out. For example, patterns and castings would be ordered from the departments now strike bound. Thus, defense work was inextricably bound up with regular activities, and ceased with the strike. While the union immediately offered to let defense workers into the plant, the organization of a separate and distinct group on national defense would take time, and it would be impossible to provide them with all customary facilities.

The strike is also holding up completion and production of the magnesium foundry, which will eventually supply a goodly portion of its output to Pratt & Whitney as well as the Ford aircraft plant. An educational order for landing gears was also stopped.

Another ill effect of the strike upon the ability of the Ford Co. to carry out its national defense assignments on schedule is this: the planning, purchasing and testing departments were unable to function. Time lost here cannot be made up by potential suppliers. In the case of the bomber parts program for example, it would be practically impossible for a new subassembly drawing, as turned over by the engineers on the west coast, to proceed into the planning department in the Rouge organization itself. So delays in getting the bomber program into effect bear a direct relationship at least to time lost because of the strike.

## Latest Defense Contracts

WASHINGTON—Recent U. S. Government contract awards include: Scovill Mfg. Co., Waterbury, Conn., artillery material, $4,200,000; Studebaker Corp., South Bend, Ind., trucks, $1,373,171; Ford Motor Co., Dearborn, Mich., trucks, $1,417,673; and Aviation Mfg. Corp., Williamsport, Pa., spare parts, $1,513,333.

## Almost A Million Trained Workers Sought in Britain

LONDON—Three-quarters of a million workers must be added to the Britain's wartime productive resources in the next eight months, indicates B. C. Jenkins, chief inspector of munitions labor supply, Ministry of Labor and National Service, in a paper, "Utilization and Training of Labor under War Conditions", which he presented at a recent meeting of the Institution of Productions Engineers. These people must be acquired from the ranks of women and men outside the military age limits. Women are already employed in the manufacture of air frames, engines, guns, tanks, and torpedoes. Besides undertaking fitting, assembling and inspection, women are working capstan lathes, milling, grinding, and gear cutting machines. Returns supplied by industry indicate that 40 per cent of the total labor supply is skilled.

## Expand Munitions Plants With New Appropriations

WASHINGTON—Money is now available for new expansion of munitions plants totalling about $1,300,000,000. This includes $750,000,000 from the British-aid appropriation and $550,000,000 from the Fifth Supplemental Defense appropriation. The two funds, however, are being consolidated into one. Allocation of the money to different types of munitions production is being held up until the British (who, War Department officials say, move rather slower than we do) make up their minds as to what they want.

Preliminary estimates indicate that 100 new munitions plants will be built. In preparation for the new program, OPM has set up a plant site committee headed by Director of Purchases Donald Nelson and including labor and agriculture representatives to pass on sites of new plants with an eye to geographic decentralization and use of available labor. Similarly, the War Department's existing site planning committee has had its powers enlarged to cover determination of priorities as between different plants as well as simple selection of sites.

Although the new plant program is still indeterminate, it looks probable that about a third will consist of powder and explosives plants and the remainder will show strong emphasis on aircraft, aircraft armament, and small arms.

Expansion underway to date of this country's armament capacity amounts to about 784 plants built or expanded at a cost of $2,138,000,000. The government or the RFC have directly financed 302 of these at a cost of $1,574,000,000, while the British have financed 61 at a cost of $171,000,000.

# WATCHING WASHINGTON

**Critical British ship shortage should be eased by U. S. seizures and construction programs. Emphasis is on standardized cargo and "box" types. Further price control methods are contemplated**

By BLAINE STUBBLEFIELD

WASHINGTON—Last week President Roosevelt made his first move under the $7,000,000,000 lend-lease appropriation to aid British shipping by allocating $500,000,000 to the Maritime Commission for construction of 212 steel cargo vessels for England. This is in addition to the 200 "pointed boxes" which will sail under the U. S. flag to relieve British ships for the combat zone, and 60 vessels under contract to the British by Todd Shipbuilding, plus 122 standard "C" design cargo ships under contract to be delivered in the regular 50 ships a year program. This totals 594 merchant ships, all being built by the Maritime Commission. Some of the 76 "C" ships already delivered will be turned over to England.

About half the 212 British ships will be the emergency "pointed box" type, and half will be standard "C" type, including some tankers. The President proposes that 56 new shipways be constructed in existing plants, 28 in six yards now building standard designs. Twenty-eight more ways will be built in the seven emergency yards contracted by the Commission last winter. No new yards are contemplated under this program.

This may be only the beginning of what will be the world's biggest ship launching. During the World War and immediately after, this country built 2,300 ships. At that time the merchant fleets of France, Italy, Japan, Holland and others served the Allies. Now, although Britain has taken over much of the shipping of those countries, heavy losses are not being replaced. To the German submarine menace has been added the dive bomber and the low-flying torpedo airplane. Though the need is great, there is no point as yet in ordering more ships than can be built. For the present the U. S. will build all it can build, and contracts mean nothing. Later, when we have the production momentum to back it up, we may start a big program to impress the Axis who knows that none of our 2,300 World War ships went into U. S. service before the Armistice, although some did go to the British.

U. S. is to avoid hasty building of inefficient box ships insofar as is commensurate with the need for speed. Three reasons: A good ship, like the "C" design, will do the work of one and one-half box bottoms because it's faster; efficient ships can be used in trade, against competition, after the war; efficient "C" ships are standardized anyway, engineers and workmen are trained on their construction, and building is not too slow.

But insofar as we build box ships beyond existing capacity, and that will be extensive in proportion to the urgency for speed, the Commission aims to bring in companies whose production is somewhat related to ships, such as steel barges, bridges, and all manner of plate work. These companies would go back to their regular work after the war, whereas emergency ship concerns would necessarily fold up. Manufacture of parts by isolated concerns for assembly at yards is still policy, but there are limitations, such as increased welding.

Ship builders will get steel; cargo space is A-1 on Britain's priority schedule and few special steels are needed in maritime construction. There is a tight situation in high-pressure boilers and turbines, largely due to Navy construction. Only the "C" ships take turbines; the box bottoms take reciprocating engines.

The Commission is having some difficulty with procedure. At present it is compelled by law to make all contracts under the bidding system whereas Army and Navy are free to negotiate. Shipbuilders prefer negotiation as it affords protection against unforeseen costs. A bill is being rushed through Congress to authorize negotiation for the Maritime Commission; it will also fix a 10 per cent profit limitation as compared with the seven per cent limit of the Navy.

### AIRCRAFT PRODUCTION RISES

WASHINGTON—Plane production, which bumped along discouragingly through the tooling up period, is now beginning to rise. March output was up to 1,216 from 972 in February. Particularly encouraging is the increase in tactical types unofficially estimated at 575. Biggest part of the increase is believed to be in pursuit ships, estimated at 275 for March. Heavy four-engine bombers probably amounted to about 25, medium two-engine bombers to 220, light two-engine attack bombers to 55. Some 620 or so trainers are probably included and perhaps 25 commercial airplanes.

It is being said that, to feed and arm Britain and other powers fighting the Axis, the U. S. may be forced to reduce work on our two-ocean Navy in favor of merchant ship construction. If Britain shows increasing strength, the big Navy becomes less urgent. If Britain weakens, the U. S. will be compelled to rush the Navy even more, and might perforce hasten the defeat of England by diverting munitions and planes to our own forces. All indications are that U. S. confidence in the Empire's power is increasing. President Roosevelt's seizure of the 69 Danish, Italian, and German ships in our ports has afforded the anti-Axis powers a much needed breathing spell.

### Price Control—An Important Element

Price control is rapidly becoming an important element in Washington's new war economy. To date maximum price schedules have been imposed on aluminum scrap, zinc scrap, iron and steel scrap, used machine tools, and, temporarily, coal. Price ceilings on lead and copper are in the offing. There is no very clear legal basis for these price controls; they are being imposed on the threat that emergency powers of the government, plant seizure, priorities, and the like, will be applied against violators.

Although it is being argued within the administration that all prices ought to be frozen immediately, there is no present intention of dealing with consumer prices. It is hoped that control of the price of underlying materials on a one-by-one basis can keep the general price structure in line. If it proves necessary to go beyond this, general price legislation will be sought. Establishment of a new price administration within the Office of Emergency Management with Leon Henderson at its head is expected.

### Reorganize OPM Division

Donald Nelson's Division of Purchases in OPM has been reorganized. Activities are expanding beyond the bedsheets and canned goods to which it originally confined itself and it is now broken down into several sections. One is responsible for clearing all defense contracts over $500,000. This is generally a formality, but provides a major means by which OPM keeps a check on Army and Navy. Other branches deal with buying policy, such matters as contract terms, timing of purchases, and the like, on different groups of commodities. Of particular interest to metal working industries is the section on industrial and strategic materials headed by John Sanger, U. S. Gypsum Co.

## Bulletins on Farming Out Worry About Production

WASHINGTON — Builders of light planes, the 45-75-hp. aerial flivers that have come nearer than any other aircraft to achieving a mass market, are badly worried as to whether they'll be able to stay in business. Biggest worry at the moment is priorities on materials, but their labor forces, too, are being eyed greedily by the military manufacturers, and at any time they could be directed by OPM to devote their facilities to subcontracting. For the present they are not getting aluminum and are living on inventories which will carry most of them into April. By that time some more or less permanent arrangement will probably have been worked out as to their future. There is hardly any chance that the light plane builders will be allowed to go ahead with their plans to expand output from 6,000 planes last year to 10,000 in 1941. Probably they won't be permitted to continue selling to private flyers. Most likely outcome is that they will have to restrict themselves to supplying schools in the Civil Pilot Training Program, which has been officially recognized as of defense value. This would amount to just about 6,000 planes this year.

## OPM TO AID SMALL FIRMS

WASHINGTON—OPM is considering a plan to facilitate entrance of smaller firms into munitions production by providing contractors with samples as well as blueprints of items to be produced. Thus smaller shops without much experience in highly technical ordnance drawings can get an idea whether it is within their scope.

## Urge Passage of Bill To Relax Patent Laws

WASHINGTON — Assistant Attorney General Arnold urges the passage of pending legislation which would forbid injunctions in favor of holders of patents vital to the defense program during the emergency. He said that patent restrictions in range finders, fire control mechanisms, carbide, tungsten and magnesium are "scandalous". He insisted the government should have the right to step in at the start instead of waiting and going through litigation. Another pending bill would prohibit application by U. S. citizens for foreign patents except by permission of the Patent Commissioner; it would prohibit the issuance of a U. S. patent to any citizen who applies or participates in an application for a foreign patent. Both of these proposals are considered vital to military secrecy and to the expeditious production of military orders, and no doubt will be passed.

## TRAIN 60,000 ENGINEERS

WASHINGTON—More than 60,000 engineers, chemists and other technically trained men now employed in industry are taking advanced training through extension courses conducted jointly by engineering schools and industries. The plan, which is sponsored by the U. S. Office of Education, offers more than 1,000 courses. Some 5,000 or more students in engineering schools are taking special courses. The trend is toward the entire effort being made on in-industry training of men who already have some specialized experience.

## Bulletins on Farming Out Methods Prepared by OPM

WASHINGTON — "Farming Out Methods", a bulletin prepared by the Labor Division, Office of Production Management, has just been published. The new bulletin contains information for government purchasing agents, prime contractors, subcontractors, and community defense organizations, concerning successful farming out techniques now being practiced by various private companies, and the pooling of resources by local, regional and labor management groups. Copies of the bulletins may be secured by writing to the Labor Division, Office of Production Management, Washington, D. C.

## U. S. Government Contracts Awarded To Metal-Working Firms

*(Does not include contracts under $100,000)*

| Source | Agency | Commodity | Amount |
|---|---|---|---|
| The McKay Co., Pittsburgh, Pa. | Navy | Chains and fittings | $279,859 |
| Thermador Elec. Mfg. Co., Los Angeles, Calif. | " | Practice bombs | 119,700 |
| Babcock & Wilcox Co., Barberton, Ohio | War | Parts for boilers | 103,573 |
| Wall Mfg. Supply Co., Pittsburgh, Pa. | Navy | Practice bombs | 286,960 |
| Kilgore Mfg. Co., Westerville, Ohio | War | Hand grenade fuses | 267,376 |
| American Steel & Wire Co., New Haven, Conn. | Navy | Jackstays | 238,300 |
| Jones & Lamson Machine Co., Springfield, Vt. | War | Lathes | 148,677 |
| Industrial Brownhoist Corp., Bay City, Mich. | Navy | Cranes | 120,095 |
| Orton Crane & Shovel Co., Chicago, Ill. | " | " | 238,824 |
| Anthony M. Meyerstein, Inc., Brooklyn, N. Y. | " | " | 319,280 |
| Star Iron & Steel Co., Tacoma, Wash. | " | " | 238,500 |
| Dravo Corp., Neville Island Branch, Pittsburgh, Pa. | " | " | 232,000 |
| R. W. Kaltenbach Corp., Bedford, Ohio | " | " | 236,500 |
| Consolidated Machine Tool Co., Rochester, N. Y. | " | Planer | 113,685 |
| Wolf Co., Chambersburg, Pa. | War | Cartridge assys. | 272,779 |
| F. J. Stokes Machine Co., Philadelphia, Pa. | " | Presses | 196,950 |
| McKiernan Terry Corp., Dover, N. J. | " | Staking machines | 128,846 |
| The Auto Car Co., Ardmore, Pa. | " | Tractor-trucks | 1,256,340 |
| Douglas Aircraft Co., Inc., Santa Monica, Calif. | " | Airplanes | 1,195,864 |
| Freeport Point Shipyards, Inc., Freeport, L. I., N.Y. | Navy | Aircraft boats | 226,296 |
| Diamond T Motor Car Co., Chicago, Ill. | War | Trucks | 737,154 |
| Indian Motorcycle Co., Springfield, Mass. | " | Motorcycles | 857,000 |
| Harley-Davidson Motor Co., Milwaukee, Wis. | " | " | 870,360 |
| Crane Co., Washington, D. C. | Navy | Pipe fittings | 249,972 |
| General Motors Corp., Guide Lamp Div., Anderson, Ind. | War | Cartridge cases | 4,872,900 |
| Federal Screw Works, Detroit, Mich. | " | Fuse parts | 232,725 |
| Russakov Can Co., Chicago, Ill. | " | Bodies and fins for bombs | 129,000 |
| American Forge Division, Chicago, Ill. | " | Shell forging | 440,000 |
| Moline Forge, Inc., Chicago, Ill. | " | " " | 496,000 |
| Pressed Steel Car Co., Chicago, Ill. | " | " " | 2,191,000 |
| A. O. Smith Corp., Milwaukee, Wis. | " | Bomb bodies | 3,561,500 |
| Stewart-Warner Corp., Chicago, Ill. | " | Fuses | 2,798,983 |
| Rheem Mfg. Co., Chicago, Ill. | " | Fins for bombs | 122,612 |
| Revere Copper & Brass, Inc., Chicago, Ill. | " | Cartridge cases | 2,235,200 |
| Ware Bros. Div., Chicago Roller Skate Co., Chicago, Ill. | " | Boosters | 995,807 |
| Elec. Household Utilities Corp., Hurley Machine Div., Cicero, Ill. | " | Fuses | 776,141 |
| Economy Fuse & Mfg. Co., Chicago, Ill. | " | " | 605,505 |
| Ingersoll Steel & Disc. Div. of Borg-Warner Corp., Chicago, Ill. | " | Cartridge cases | 7,960,500 |
| Briggs & Stratton Corp., Milwaukee, Wis. | " | Fuse | 1,274,210 |
| Frost Co., Kenosha, Wis. | " | Cartridge cases | 301,696 |
| Rheem Mfg. Co., Chicago, Ill. | " | Bodies and fins | 3,051,657 |
| National Cash Register Co., Dayton, Ohio | " | Fuses | 174,000 |
| Consolidated Machine Tool Corp., Rochester, N. Y. | " | Planers | 167,470 |
| Kilby Steel Co., Anniston, Ala. | Navy | Cutters | 155,415 |
| Westinghouse Elec. & Mfg. Co., Washington, D. C. | " | Draft blowers | 2,079,570 |
| Leece-Neville Co., Cleveland, Ohio | " | Parts for diesels | 147,575 |
| Armstrong Cork Co., Pittsburgh, Pa. | War | Machining shell | 414,750 |
| Gen. Motors Corp. (Chev. Div.), Detroit, Mich. | " | Tractor-trucks | 112,350 |
| Le Tourneau Co. of Georgia, Toccoa, Ga. | " | Machining shell | 5,876,250 |
| Walworth Co., Inc., Chicago, Ill. | " | " " | 2,088,360 |
| International Harvester Co., Chicago, Ill. | " | " " | 1,014,000 |
| J. I. Case Co., Racine, Wis. | " | " " | 4,696,038 |
| Pullman-Standard Car Mfg. Co., Chicago, Ill. | " | Shell | 1,575,280 |
| Giddings & Lewis, Fond du Lac, Wis. | " | Boring machine | 6,837,500 |
| Tuthill Pump Co., Chicago, Ill. | " | Shell | 196,140 |
| International Harvester Co., Chicago, Ill. | " | Practice shell | 108,000 |
| Link Belt Co., Chicago, Ill. | " | Anti-aircraft guns | 212,000 |
| Giddings & Lewis, Fond du Lac, Wis. | " | Boring machine | 1,175,000 |
| Columbian Iron Works, Chattanooga, Tenn. | " | Machining shell | 1,035,480 |
| International Harvester, Milwaukee, Wis. | " | Adapters | 932,400 |
| Eclipse Mach. Div., Bendix Avia. Corp., Elmira Hts., N. Y. | " | Practice shell | 112,964 |
| Metal Specialty Co., Cincinnati, Ohio | " | Booster assys. | 565,972 |
| Morse Chain Co., Detroit, Mich. | Navy | Diesel engine parts | 129,970 |
| American Chain & Cable Co., Inc., Page Steel & Wire Div., Monessen, Pa. | " | Welding electrodes | 245,400 |
| Lincoln Elec. Co., Cleveland, Ohio | " | " " | 438,690 |

## NAMES in the NEWS

B. F. Bower, formerly chief engineer, Howell Co., St. Charles, Ill., has resigned his position. He has spent many years in designing and perfecting tube fabricating equipment and other metal-working machines for making tubular steel. He is organizing a company which will shortly go into production on tube fabricating machines.

W. K. Ebel, 42, formerly chief engineer, The Glenn L. Martin Co., Baltimore, has been named vice-president in charge of engineering.

J. K. Beeson, formerly assistant general manager of sales, Pittsburgh Steel Co., has been elected vice-president. He has been associated with the company since 1929.

E. Bosworth Grier, son of the late Edward R. Grier, has been elected a director, Arrow-Hart & Hegeman Electric Co., Hartford, Conn., to succeed his father. Mr. Grier has been connected with the company since 1918; he was elected secretary in 1930.

S. H. Hammond, formerly manager, the Appliance Division, has been named Director of the Field Force, Whiting Corp., Harvey, Ill. M. F. Becker, vice-president, has been appointed co-manager of the Equipment Division. He has been Director of the Field Force.

Andrew Hutton has been named Works Manager, Robins Conveying Belt Co., Passaic, N. J. Mr. Hutton was recently chief engineer, Davis Engineering Corp., Elizabeth, N. J.; previously he was vice-president and general manager, Taylor Mfg. Corp., Milwaukee, Wis.

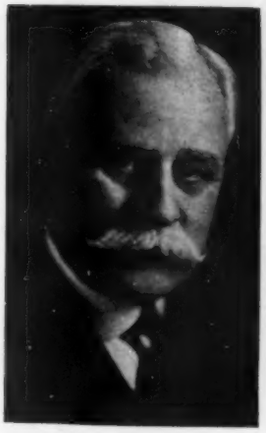
Phelps Ingersoll, president and general manager, Wilcox, Crittenden & Co., Inc., Middletown, Conn., has been elected first vice-president, American Hot Dip Galvanizers Association, Inc., Pittsburgh, Pa.

H. W. Mons celebrated this month his 40th anniversary with Hill-Clarke Machinery Co., Chicago. Now vice-president, Mr. Mons joined the organization in 1901.

John D. Porter, formerly production manager, Detroit truck division, Chrysler Corp., has been appointed Works manager, Federal Motor Truck Co.

Robert H. Ahlers, general plant manager, Pontiac Motor Div., General Motors Corp., has been placed in charge of all defense work. Buell Starr has been appointed defense plant superintendent; Robert Blackinton becomes master mechanic; Fred Maltbie heads the defense department; and Leonard J. Redford will have charge of defense purchases.

*Chairman and President, American Brass Co.*



JOHN A. COE

CLARK S. JUDD

*Studebaker Aide*

E. E. RICHARDS

John A. Coe, president, American Brass Co., Waterbury, Conn., a subsidiary of Anaconda Copper Mining Co., has been elected chairman of the board. Clark S. Judd, formerly vice-president, succeeds Mr. Coe as president. Arthur H. Quigley has been elected executive vice-president.

R. S. Marthens, formerly manager, the Westinghouse Gearing Div., has been appointed staff assistant to the manager of the Canton Ordnance Div., Westinghouse Electric & Instrument Co. Mr. Marthens has been manager of Westinghouse Gearing Div. since 1934.

H. Lee Murphy, general manager of the Sager Div., Chicago, Ill., subsidiary of the Yale & Towne Mfg. Co., Stamford, Conn., has been elected president and a director of the Eagle Lock Co., Terryville, Conn. George J. Macklin, who was assistant to Mr. Murphy at the Sager Div., has been elected vice-president, Eagle Lock Co.

Edward C. Stoever has been appointed manager, Agency and Specialties Div. of the Northwestern District, Westinghouse Electric & Mfg. Co.

E. E. Richards has joined the Studebaker Corp. as assistant to the president.

Harry L. Strube has been appointed chief engineer, Eastern Div., Link-Belt Co., Chicago. He succeeds F. F. Waechter, who has resigned after completing 43 years of service.

George L. Todd, comptroller, The Bullard Company, Bridgeport, Conn., has been named a member of the Board of Directors.

A. N. Wolf has been transferred to the St. Louis office, Cutler-Hammer, Inc., Milwaukee, Wis.

## PLANT EXPANSION

Addressograph Multigraph Corp., Cleveland, will add a new plant to its existing facilities at a cost of $750,000. The new construction will provide about 76,800 sq. ft. of floor space and is scheduled to be put into operation in July.

Aluminum Co. of America, Los

*Heads Pontiac's Defense*

ROBERT H. AHLERS

*Federal Works Manager*

JOHN D. PORTER

*A. H. d'Arcambal, outgoing president of the American Society of Tool Engineers, congratulates Frank W. Curtis, chief engineer, Van Norman Machine Co., Springfield, Mass., who has been elected president of the Society. The other officers are: Otto W. Winter, factory manager, Columbus McKinnon Chain Corp., Tonawanda, N. Y., first vice-president; Ray H. Morris, Hardinge Bros., Elmira, N. Y., second vice-president; Frank R. Crone, Lincoln Motor Co., Detroit, reelected treasurer; and Clyde L. Hause, Gorham Tool Co., Detroit, who has been named secretary*

Angeles, Calif., will erect a new die shop and remelting building at a cost of $39,200.

Cutler-Hammer, Inc., Milwaukee, is erecting a $20,000 addition to its plant.

The Gerlinger Brass & Aluminum Foundry, Milwaukee, has obtained a permit to construct added facilities.

Hughes Aircraft Co., Glendale, Calif., will build a new aircraft manufacturing plant at Los Angeles. The plant will cover an area of 36,000 sq. ft., and will cost $302,500.

Jacksonville Shipbuilding Corp., Jacksonville, Fla. will increase its shipbuilding facilities. The plant will include a new unit, expected to be the largest in the world, at a cost of approximately $30,000,000.

Lockheed Aircraft Corp. is erecting a new steel addition to its existing plant facilities at a cost of $62,000.

National Twist Drill Co., Rochester, Mich., will construct a 43,000 sq. ft. addition to its existing plant facilities.

North American Aviation Co., Los Angeles, will erect a new addition to its plant at a cost of $40,000. The expansion will increase the floor area 17,600 sq.ft.

Pioneer Engineering & Mfg. Co., Detroit, is moving into its new plant. The new construction, completed in accordance with defense recommendations of the FBI, Navy and Army, has complete protection against saboteurs.

Rohr Aircraft Co., Chula Vista, Calif., will expand its present factory facilities to provide 147,000 sq. ft. of additional floor space. The expansion will cost $275,000.

The Trackson Co., Milwaukee, has obtained a permit for the construction of a $20,000 addition to its existing plant facilities.

## BUSINESS ITEMS

The American Chain & Cable Co., Bridgeport, Conn., will move its subsidiary, the Reading-Pratt & Cady Div., Hartford, to Reading, Pa.

Industrial Wire Mfg. Corp., Los Angeles, has been formed with a capital of $50,000.

The Mine & Smelter Supply Co., Denver, Colo., has been appointed exclusive representative in the Rocky Mountain Region for Gisholt Machine Co., Madison, Wis.

Southwest Steel Rolling Mill, Inc., Los Angeles, has been organized with 20,000 shares of no par value capital stock.

West Coast Shipbuilders, Ltd., was recently incorporated at Victoria, B. C. with a capitalization of $10,000.

Zapon-Keratol Div., Atlas Powder Co., Newark, N. J., is the new name of the Keratol Company. The entire Keratol organization, personnel and policies, are being continued in the new division under the same management.

## OBITUARIES

William J. Fleming, 73, formerly sales manager, Bourne-Fuller Co., Cleveland, and more recently with Republic Steel Corp., Cleveland, died recently.

Herman A. De Vry, an inventor and manufacturer of a number of devices which developed the motion picture industry, died recently of a heart attack. Mr. De Vry, who was 65 years old, was founder and president of the De Vry Corp. which manufactures motion picture equipment.

Gustave R. Maertins, Sr., who in 1901 entered into partnership with the Fisher Bros. who in turn later founded the Fisher Body Corp., died recently.

J. Adam Schweitzer, president, Diamond Expansion Bolt Co., Inc., Garwood, N. J., died recently at 55.

Walter Thomas, for 25 years production superintendent, Transue & Williams Steel Forging Corp., Alliance, Ohio, died recently at the age of 63.

James H. Van Pelt, 58, founder and owner, Owosso Bronze Bearings Co., Flint, Mich., died recently.

## MEETINGS

American Gear Manufacturers' Association. Annual convention. Hot Springs, Va., the Homestead, May 5–7.

American Iron and Steel Institute. Annual meeting. Waldorf-Astoria, New York, N. Y., May 22.

American Society of Mechanical Engineers. Semi-annual meeting. Kansas City, Mo., June 16–20.

American Society for Metals, Western Metal Congress and Exposition. Pan-Pacific Auditorium, Los Angeles, Cal., May 19–23.

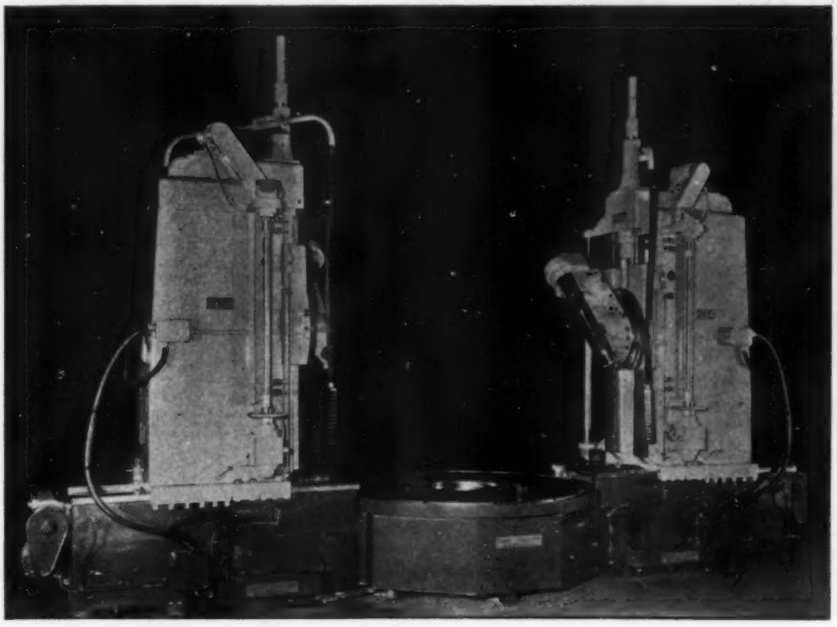
American Society for Testing Materials. Annual meeting to be held in conjunction with an exhibit of testing apparatus at the Palmer House, Chicago, Ill., June 23–27.

Associated Machine Tool Dealers of America. Spring convention. The Mayflower Hotel, Washington, D. C., April 28.

National Metal Trades Association. Annual convention. Palmer House, Chicago, Ill., May 8 and 9.

Society of Automotive Engineers. Summer meeting. The Greenbrier, White Sulphur Springs, W. Va., June 1–6.

# SHOP EQUIPMENT NEWS



## Gould & Eberhardt Universal Hobbing Machine Especially Suitable for Cutting Turbine Gears

Large marine turbine reduction gears can be cut efficiently with the No. 120H universal gear hobbing machine developed by Gould & Eberhardt, Newark, N. J. This machine has a nominal capacity for gears of 120-in. diameter, 48-in. face width at 45 deg. and 2½ diametral pitch, but at low helix angles will accommodate gears up to 160 in. in diameter. It weighs 138,000 lb. and requires a 20x30-ft. floor space.

Two opposite cutter heads permit both right- and left-hand portions of double-helical gears to be cut simultaneously, resulting in a substantial increase in production. The right-hand cutter head feeds downward while the left-hand feeds upward. At any time either head may be disconnected and the machine operated as a conventional single head machine. Hob slides are mounted on separate stanchions which travel on double rectangular guides provided with independent adjustments. Each stanchion is adjustable along its respective bed for gear diameter and tooth depth. Swivel heads have 180-deg. adjustments to cut right- and left-hand helices of any angle. Separate power devices permit each head to be swiveled quickly to the correct angle.

Driving motors and main gear mechanism are placed away from the machine proper to provide thermal isolation. For the same reason all driveshafts are journaled outside the machine. Tapered roller bearings 54 in. in diameter take the radial table thrust, while flat annular bearings carry the vertical load. Maximum table runout is 0.0003 in. A new dual-lead worm permits easy adjustment for minimum backlash. Use of two sets of worms and gears—a coarse pitch for roughing and a fine pitch for finishing—also increases accuracy and life.

Hob spindles have reverse-taper bearings, with the small diameter at the nose end of the spindle. This design provides closer support for small-diameter hobs and eliminates long arbors and spacing collars, permitting a large-diameter spindle at the drive end and materially increasing rigidity. Independent adjustment maintains constant diameter and, being extremely sensitive, corrects tooth form inaccuracies caused by excessive play. Adjustments are made without dismantling the spindles.

A circulatory pressure lubrication system continuously supplies filtered oil to the mechanism in the main gear case, to the work table, and to the two index worm-gear sets. Cascade oiling is provided for the change gears inclosed in oil-tight compartments, the lower portions of which form the main reservoir for the lubricating system. Hob drive gears run in individual oil baths. An intermittent high-pressure system lubricates all bearings within the two stanchions, the horizontal guide ways, hob carriage guide ways, hob driving parts, swivel heads and main hob spindle bearings. A complete duplicate lubrication system is provided as a precaution against lubrication failure.

Eleven motors operate the machine. Main drive, lubricating and coolant motors are d.c.; the rest a.c. Direct current is used for these motors so

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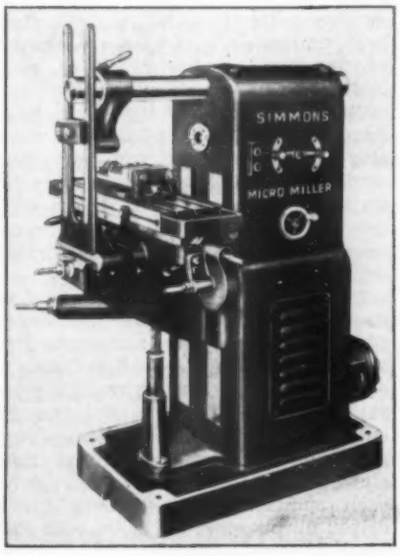
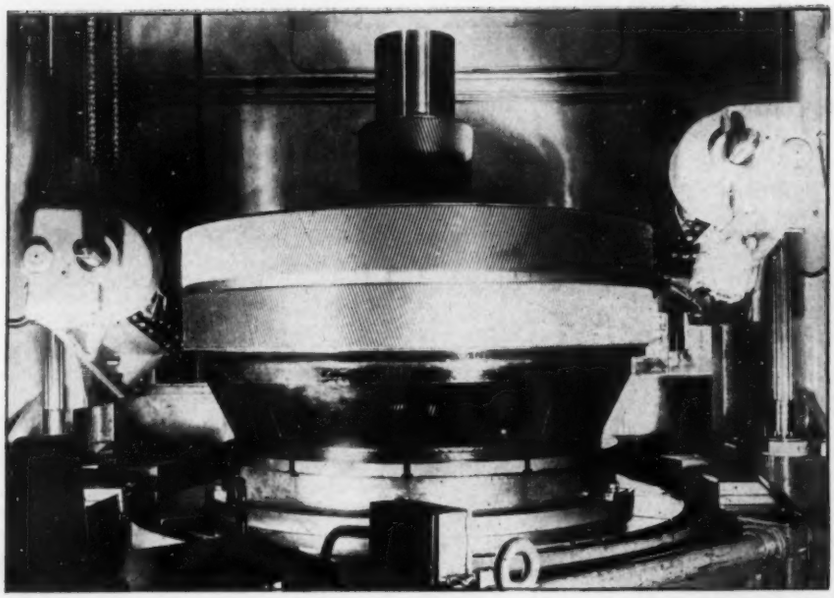
## Simmons "Micro-Miller" Produces Small Parts

Simmons Machine Tool Corp., Albany, N. Y., has developed the No. A-1 "Micro-Miller" milling machine especially for the rapid production of small parts. It is said to be particularly suitable for use in plants manufacturing small firearms and airplane parts, in toolrcom repair shops and in similar applications.

The tool features "Micro-Speed" drive, the variable-speed unit employed in Simmons turret lathes and standard and heavy duty engine lathes. This drive, mounted inside the column, provides a range of spindle speeds from 38 to 500 at the turn of a handwheel.

The machine has the following range of feeds: longitudinal, 34 in.; cross, 8 in., vertical, 18 in. The working surface of the table is 27x8 in.





*Machining time on turbine reduction gears is cut virtually in half by simultaneous operation of two heads on this G.&E. universal gear hobbing machine. Either head can be operated independently if desired*

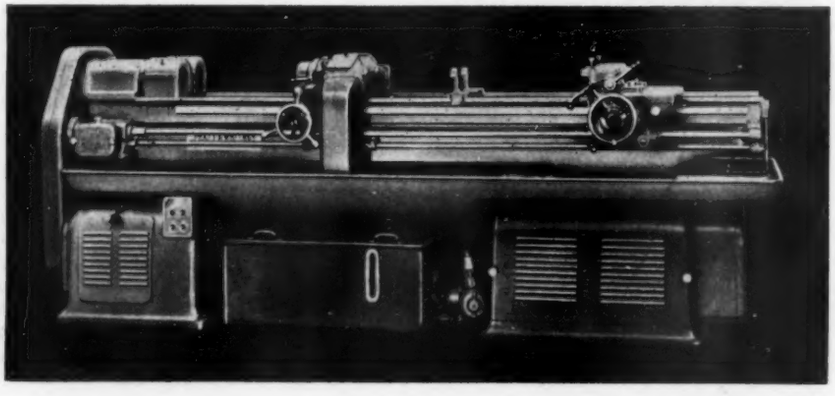
that, in the event of power failure during a finishing cut, standby storage batteries can keep the machine in continuous operation until the power is restored or the cut is finished. This switch to emergency power is accomplished automatically. Entire control system is housed in a wall of the air-conditioned room in such a way that any heat is dissipated to the outside. Signal lights on the panel board instantly warn of any untoward circumstance in the machine operation, such as a drop in lubricant or coolant flow. Five a.c. motors are used for traversing.

Every effort has been exerted for utmost accuracy in the design and manufacture of the machine. Stanchion alignment is within 0.00025 in. in 4 ft. Accumulated lead error is within 0.001 in. in 4 ft. Average periodic error corresponding to one revolution of the index worm does not exceed 0.00005 in. on a gear 120 in. in diameter, and accumulated pitch error is less than 0.002 in. on the same size gear. Finished gears are said to require no subsequent lapping.

## Pratt & Whitney Deep Hole Driller Designed to Handle Wide Range of Work

Pratt & Whitney Div., Niles Bement Pond Co., West Hartford, Conn., has developed the Nos. ½B and 1B deep hole drillers so that they are capable of handling a wide range of work including rifle barrels, automotive connecting rods, hollow spindles, wrist pins, boring bars, printing press rolls, stay-bolts, crank and camshafts and similar parts. Holes ⅝ in. in diameter up to 50 in. long can be drilled with the No. ½B, while holes 1 in. in diameter up to 74 in. long can be drilled with the No. 1B.

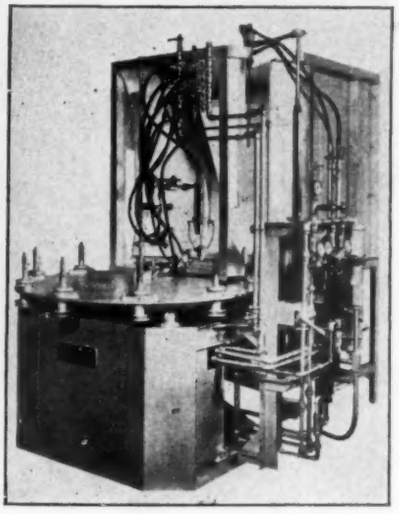
In these machines, the single flute deep hole drill remains stationary while the work revolves around it. This special type of drill has a hole throughout its length which carries high pressure oil to its tip. The oil blows the chips away from the cutting edge and out through an external flute along the drill. Separate motors drive each spindle. High pressure motor driven oil pumping units are built into the cabinet leg at the right. The machine is so arranged that the twin drilling units can be operated independently. The drill carriage has an adjustable automatic safety knock-off which will stop the machine when overloads are encountered.



## DeVilbiss Automatic Machine Coats Both Sides of Shell

A machine which efficiently coats both the inside and outside of shell automatically, speeding production and reducing labor requirements, has been developed by DeVilbiss Co., Toledo, Ohio. This machine is capable of spraying all shell sizes from 37 to 105 mm.

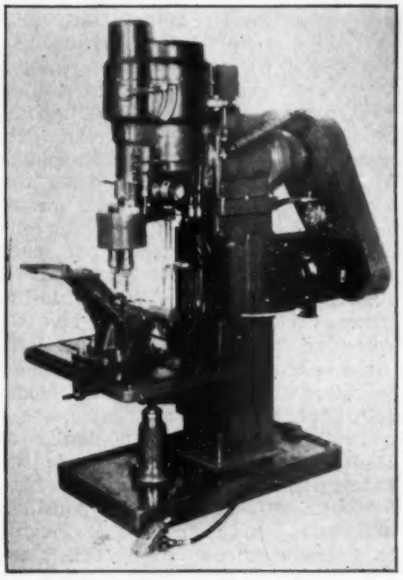
Except for loading and unloading shell on the spindles, operation is completely automatic. These spindles are located around the edge of a rotating table, to the rear of which is an overhead spray gun with an extension nozzle for the interior coating operation. As the shell comes into proper position, revolving on its spindle, the gun is inserted into it and sprays all interior surfaces. The nozzle is then removed and the table indexes to the exterior painting position. With the shell still revolving, a battery of guns coats the outside. Synchronization is such that while the interior of one shell is being coated, the exterior of the preceding one is being sprayed.



Production ranges from 300 to 720 shell an hour, varying with the size. In addition to shell, this machine is suitable for coating tail pieces and fragmentation bomb sub-assemblies.

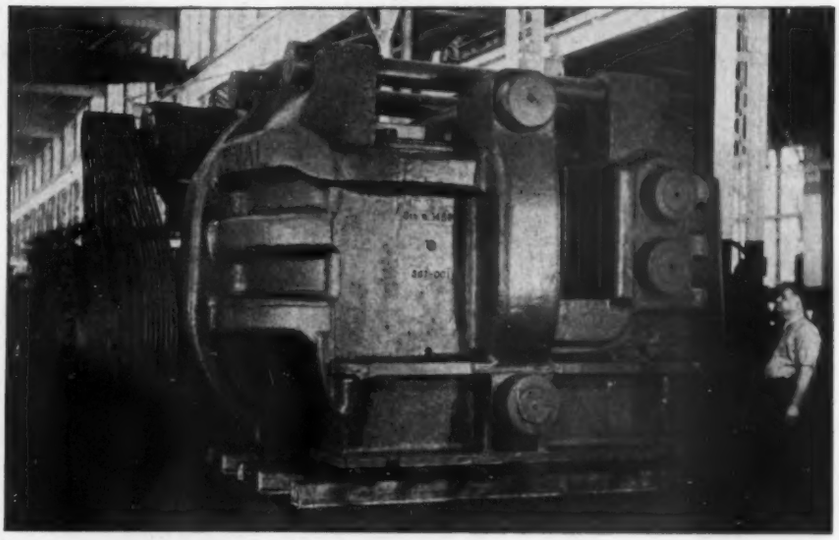
## "Hi-Duty" Tapping Machine Threads Nuts Automatically

The No. 10-A "Hi-Duty" tapping machine with "Hi-lo" gearing, equipped with a two-spindle head and semi-automatic magazine fixture, is offered by L. J. Kaufman Mfg. Co., Manitowoc, Wis. In the operation of this machine, nuts are fed to the magazines by hand



and are located beneath the taps and ejected automatically.

Twelve speeds are provided in geometric progression. The machine can also be equipped with a revolving index type fixture or any other type normally used for this class of work.



## Precision Forgings Produced at High Speed With Larger National Forging Machine

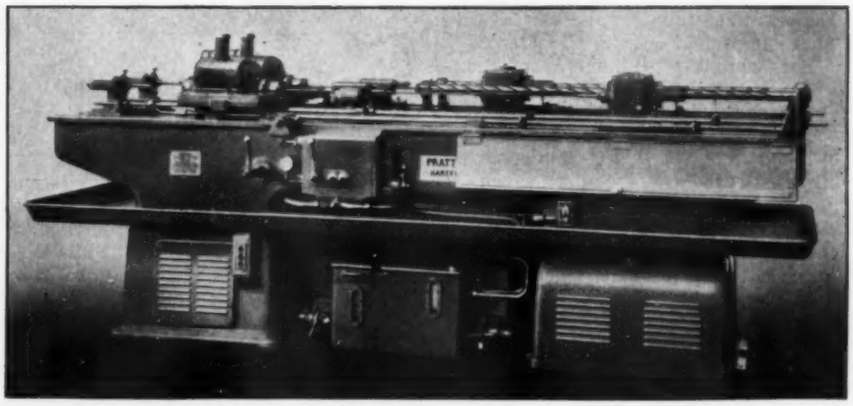
Claimed to be the world's largest, a 9-in. capacity high-speed precision forging machine has been built by National Machinery Co., Tiffin, Ohio, especially for the production of accurate forgings in sizes larger than previously possible. With a total weight of approximately 500,000 lb., this machine features extremely compact design to assure utmost rigidity.

Short, compact design is made possible by mounting the flywheel shaft in the neutral axis of the bed frame, with the overarm heading slide permitting location of the main shaft farther forward without sacrifice in tool alignment. As a result, all the bed frame weight is utilized in providing maximum stiffness.

Heading and gripping slides are of the overarm bearing-suspended type, with wedge adjustments at the sides of both slides to maintain accurate alignment. Enormous longitudinal and cross tie bars are provided, of round cross-section for minimum interference with die setting or adjustment. A tandem by-pass automatic grip relief and friction-slip flywheel protect the machine. An air-cooled friction clutch starts the machine at high speed. Easy operation helps speed production.

## Gun Barrels up to 98 In. Long Can Be Rifled With Pratt & Whitney Rifling Machines

Gun barrels up to 1⅛ in. in diameter and 98 in. long can be rifled with the No. 1Bx98 gun barrel rifling machine developed by Pratt & Whitney Div., Niles Bement Pond Co., West Hartford, Conn. Two No. ½B machines handle lengths of 30 and 50 in. with diameters up to ⅝ in.; while three No. 1B units handle lengths of 50, 74 and 98 in. at diameters up to 1⅛ in. All these machines incorporate two complete units controlled hydraulically.



In operation, the rifle barrel is held in a work spindle by a collet chuck. This mechanism automatically indexes the barrel after each rifling cut. The end of the barrel is steadied by the work end support. Toward the right of the machine are the rifling tool slides which drive the rifing tools and control their pitch by means of a leader and nut.

At the start of the operation, the rifling tool extends through the work to the tool feeding device at the extreme left. The operation starts as the pull type hook cutter is drawn to the right through the barrel. Upon its return the barrel is automatically indexed for the next groove. After each complete revolution of the barrel the rifling tool is automatically fed deeper. When the rifled grooves have reached a predetermined depth, the feed stops. This complete cycle is automatic.

Coolant is fed to the cutter through a hole which runs the length of the rifing tool. A small motor-driven brush cleans the tool of chips.

## Aluminum Aircraft Sections Joined Successfully With Progressive "Short-Wave" Resistance Welder

Aluminum alloy sections, especially those extensively used in the aircraft industry, can be efficiently welded with "Short-Wave" welder, developed by Progressive Welder Co., 3001 E. Outer Drive, Detroit, Mich. Involving an entirely new principle of operation, the process is said to produce welds in aluminum alloy with a uniformity equal to that possible in welding steel in production.

Capable of producing spot welds in aluminum alloys far beyond the strength required by government specifications, the process involves no energy accumulators, and does not require special skill on the part of the operator. Welding speeds are directly in line with those customary in the welding of sheet steel and are limited principally by the speeds at which the work can be moved between welds.

In addition to showing a striking uniformity, welds made with this process are apparently entirely free from cracks and blow holes. Not only is the actual operation of the machine exceedingly simple, but only two adjustments are required to take care of all types of welding within the capacity of the machine.

The principle on which the equipment operates is based on the use of all three phases of three-phase alternating current, the proper wave form for the weld being developed in such a manner as to permit great accuracy of current control. The flexibility of equipment permits the welding of aluminum sections totaling ¼ in. in thickness down to the thinnest weldable sheet on the same machine. It is possible, for instance, to spot weld seven pieces of 0.032-in. 24 S.T. aluminum sheet with a 150-kva. three-phase welder.

The Progressive three-phase "Short-Wave" process consists, essentially, of passing the current through a converter, which eliminates the negative portions of the wave. The resulting pulsating current has a time cycle of 300 instead of the 360 deg. The current then passes through the welding transformer. The resulting secondary current wave form is said to be ideal for welding aluminum. The current rises to its maximum almost instantly, stays at this value for practically the entire duration of the weld then drops to zero in an extremely short period of time.

A timer panel for the various sequences of the welding operation provides completely automatic operation. With it weld time can be varied anywhere from 1/72 sec. down to zero.

The complete equipment, mechanically, is almost identical with standard Progressive pedestal-type welding equipment. Welding pressures are obtained through a standard direct air-operated pressure cylinder which is mounted on the upper arm and actuates the upper welding electrode, and are so handled as to provide a "follow-through." To provide a closer and more positive connection between welding transformer and work, an air-operated secondary shunt clamp grips the upper electrode after the work is under welding pressure.

## Line of Platers' Machinery Introduced by Bruce Products

Bruce Products Corp., 5712 Twelfth St., Detroit, Mich., has developed a line of electro-platers' machinery which includes polishing and buffing lathes, straight-line polishing and buffing machines, and plating generators. These "Bruko" machines feature adjustable speed and rugged construction for long life.

The following models of polishing and buffing lathes are available for 4-in. face wheels: Model DAS, with two 2- or 3-hp. motors driving two spindles at 600 to 3,480 r.p.m.; Model VAS, with two 3-hp. motors driving two spindles at 1,800 to 7,000 r.p.m.; Model LIS, with one 3-, 5- or 7-hp. motor driving one double-ended spindle at any one speed between 1,800 and 3,600 r.p.m.; Model ROS, with one 3-, 5-, 7½- or 10-hp. motor driving one double-ended spindle at any one speed between 1,800 and 3,600 r.p.m.; Model ROD, with two 3-, 5-, 7½- or 10-hp. motors driving two spindles at any one speed up to 3,600 r.p.m.; Model RIS, same as Model ROS but with a longer spindle; Model RAS, same as Model ROS but with an adjustable speed control; and Model RID, similar to Model ROD but with motors in the base instead of at the rear.

Model RSL straight-line polishing and buffing machines are engineered to fit requirements. Model RSLR rotary polishing and buffing machines are also available.

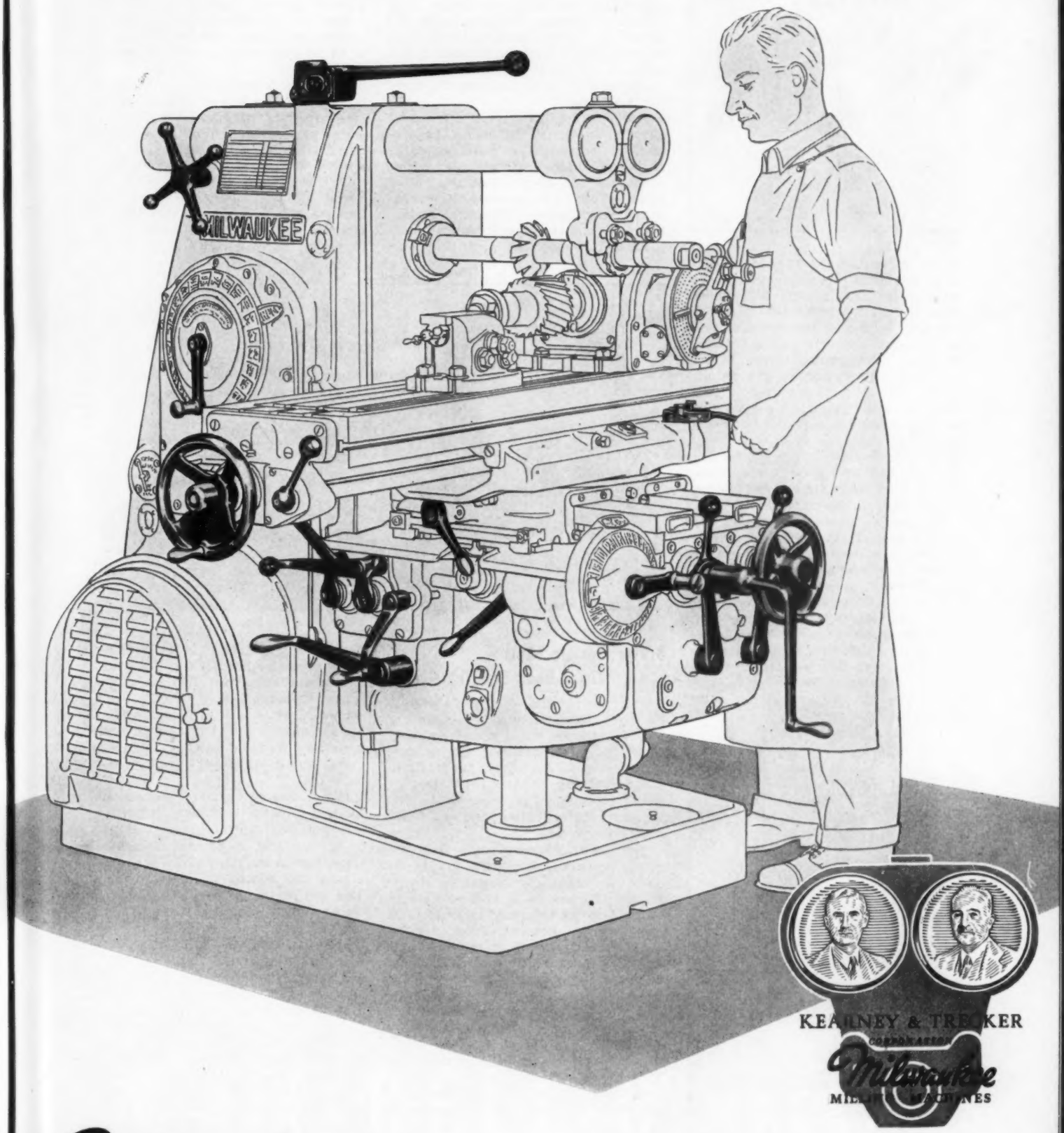
## Stokes Semi-Automatic Presses Have Controlled Closing Speed

A slow closing control feature is an outstanding development offered on "Standard" semi-automatic presses built by the Plastics Div., F. J. Stokes Machine Co., 5930 Tabor Rd., Philadelphia, Pa. By means of this control the final closing of the mold under compression may be accurately timed for 1 sec. to 20 min. Speed is timed automatically and duplicated in each cycle.

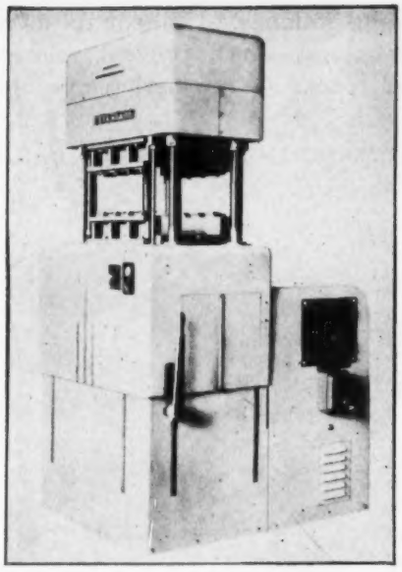
It is stated that with this controlled

Centralized controls — duplicated front and rear on many models — enable the operator to control all movements from either a front or rear position . . . all control levers have positive safety interlocks which prevent spinning hand-wheels and hand-cranks — no spring-operated mechanisms are employed.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis., U. S. A.

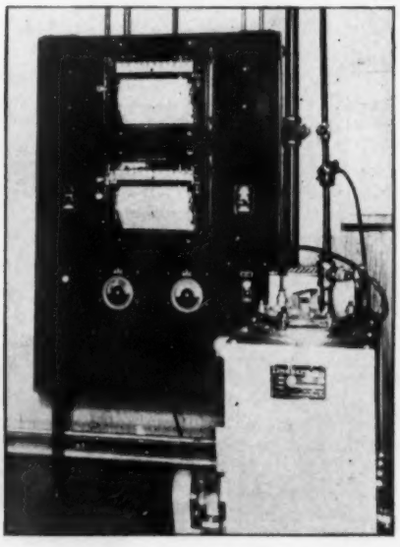



# Milwaukee MILLING MACHINES



closing action rejects can be reduced to a minimum in molding precision parts or those containing delicate inserts, and in the production of moldings with thick and thin sections. Also, maintenance cost of molds is reduced, especially when using molds having thin pins or projections which are susceptible to damage when closing speeds are rapid. Controlling speed during final closing is said also to permit use of less expensive flash type molds where they would otherwise be impractical, and that savings in material can, in some cases (flash type molds), run as high as 20 percent.

The control mechanism makes the press automatic in operation, except for the actual loading and removal of finished pieces. Thus closing, pre-heating, breathing, pressure and length of cure are not dependent on the judgment and accuracy of the operator. Adjustments are simple and can be set so that the slow closing action starts at any point in the ram travel. Speed can be adjusted while the ram is in motion. In the clear the press closes at normal high speed.



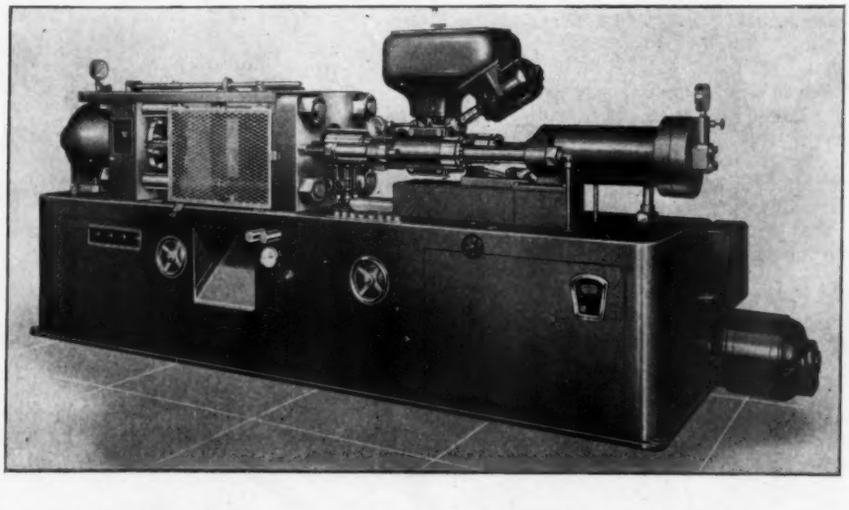
## Hydraulic 12-Oz. H-P-M Injection Molding Press Promotes Production of Plastic Parts

Hydraulic Press Mfg. Co., Mount Gilead, Ohio, has developed a 12-oz. single-nozzle injection molding press in an effort to help accelerate production of plastic parts to permit conversion of essential metals to defense needs. The machine illustrated is primarily designed for the molding of large parts where multiple injection molding is not required. Thus it is suitable to take over the work of many large die casting machines.

The machine incorporates a powerful straight-line hydraulic clamp, important for successful molding of large parts. The live hydraulic force that backs up the clamp assembly, after mold is closed, guarantees positive sealing of mold halves. This straight-line hydraulic clamp also automatically adjusts for molds of any thickness, thereby keeping die set-up time to a minimum.

Speed of the plunger is rapid, to inject large quantities of material per cycle. Circulating fluid heating system assures uniform heating of material. Force-feed of material with positive measuring permits use of the 12-oz. press for producting somewhat smaller moldings.

The press is equipped with standard H-P-M "Hydro-Power" radial piston type pressure generators. The only maintenance required of these heavy duty pumps is that after a certain number of running hours, the tapered roller bearings should be taken up. Specifications: clamp pressure, 200 tons; maximum mold size, 16½x24 in.; pressure in injection chamber, 30,000 lb. per sq.in.



## Brown Flexible Control Times Heat-Treating Cycles

Brown Instrument Co., Philadelphia, Pa., has developed an exceptionally flexible program control system using standard potentiometer controllers. This system is particularly adaptable to the completely automatic control of such heat-treating processes as annealing, normalizing, carburizing and stress relieving.

The basic instrument is a potentiometer-type controller—usually a single-point indicating or recording pyrometer, although it is also possible to use two- or three-record controllers at the same temperature. To accomplish a certain program of temperature control, the index of the controller must be moved automatically from one point to another, either upscale or downscale.

Movement of the control index is governed by a control point drive motor mounted in the instrument. This reversible motor drives the control index in either direction with minimum coasting when de-energized. Since it is impractical to use a different special-speed motor for each heating and cooling rate, an adjustable current-interrupting device is connected in series with each motor winding so that the speed of control index movement may be varied at will. This interrupter is set by adjusting a pointer on a dial.

If it is desired to hold a temperature for a certain time without any movement of the control index, this may be accomplished by using a timer. This timer breaks the current to both windings of the control point drive motor. The control index then remains stationary until one of the motor windings is again energized. The timer can be set for any number of minutes or hours.

Adaptable to nearly any desired control sequence, these program control systems are easily adjusted, have no cams to cut, will not produce false record charts, and can control multiple-zone furnaces from one master program. Momentary power failure does not alter the program or cause the cycle to begin anew.

EX-CELL-O *Precision*
BORING MACHINES

*Precision*
GRINDERS

*Precision*
MACHINES

*Precision*
GRINDERS

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## EX-CELL-O CORPORATION

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*Detroit, Michigan, U.S.A.*

Ex-Cell-O unreservedly plays its role in the nation's tremendous program for defense -- --with men, management, and plant facilities all coordinated in producing primary tools so vitally essential to this country's security.

Day and night, Ex-Cell-O is in high gear ... without any hesitation, it continues at this crucial period in America's history to shoulder its increasing responsibility as a pioneer and a leader in the development and production of precision machine tools.

Pres. Huber

President

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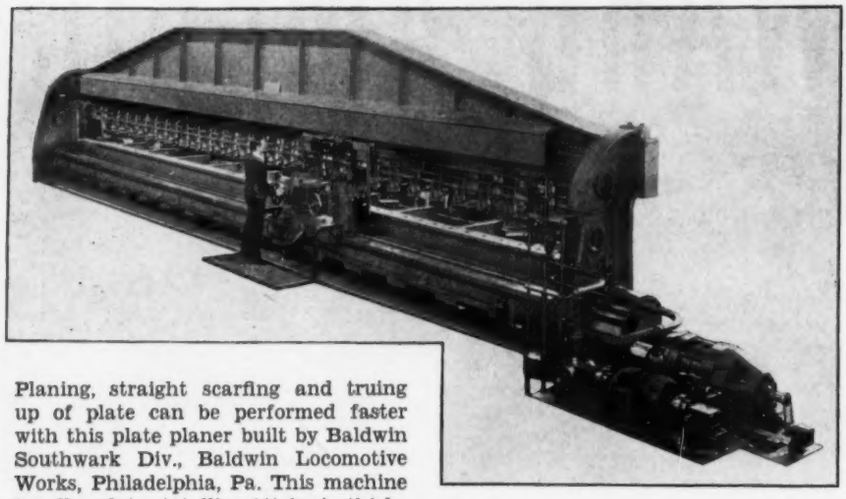
# EX-CELL-O XLO *Precision* MACHINES AND TOOLS

## Plates 9½ In. Thick up to 40 Ft. Long Machined With Baldwin Southwark Planer

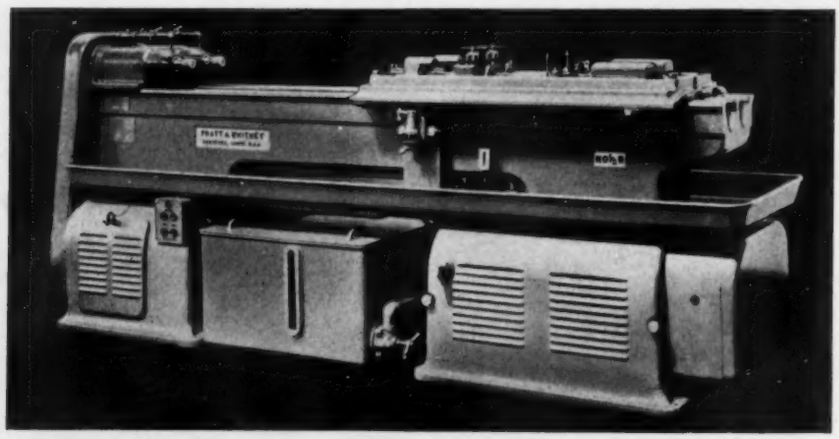


Planing, straight scarfing and truing up of plate can be performed faster with this plate planer built by Baldwin Southwark Div., Baldwin Locomotive Works, Philadelphia, Pa. This machine handles plates totalling 9½ in. in thickness up to 40 ft. long, taking a cut ⅛ in. deep and 1½ in. wide at a speed of 45 ft. per min.

The plates are held in place on the bed by 27 hydraulic cylinders which exert a total clamping force of 270,000 lb. Individual control of these cylinders is provided, and a single control may be used to operate them all at once.

Speed and accuracy are improved by double tooling which permits automatic carriage reverse and allows the operator to devote all his attention to adjusting the cut. To speed up operation further, toolholders are vertically adjustable by pushbutton control on the carriage, on which the operator rides.

Gears run in an oil bath, with the bearings supporting the drive screw fitted with removable bronze liners. Carriage nut can be removed without taking the carriage off the bed. Hydraulic pressure for the clamp cylinders is provided by a two-pressure pump. Once pressure has been built up and the plate firmly clamped, the motor and pump are automatically shut off and the pressure is maintained by a small hydraulic accumulator.



## Pratt & Whitney Deep Hole Reaming Machines Especially Suitable for Use on Rifle Barrels

Nos. ½B and 1B deep hole reamers have been designed by Pratt & Whitney Div., Niles Bement Pond Co., West Hartford, Conn., primarily for deep reaming rifle barrels. Capable of handling work up to ⅝ in. diameter 50 in. long and 1 in. diameter 74 in. long respectively, these double-spindle machines also handle efficiently any other type of deep hole reaming.

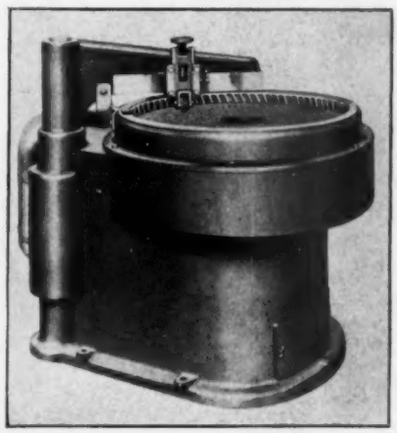
In operation, the work is held in a fixture on the work carriage, this whole unit being fed toward or away from the rotating reamer. Best results are usually obtained by feeding away from a pull type reamer. The smooth pull of the hydraulic feed, and the even power from the V-belt driven ball bearing spindle, result in holes that meet the most exacting requirements of size and finish.

Hydraulic feed, infinitely variable from 2 to 10 in. per min., permits the operator to vary the feed until the most satisfactory operating conditions are established. Rapid traverse return at 30 ft. per min. and quick-acting fixtures for loading and unloading the work result in minimum amount of unproductive time and high output.

The two reaming units are entirely separate, each having its individual spindle motor, hydraulic feed motor, and coolant pump. This enables the operator to be reloading or checking work at one spindle while the other is in production.

## Horizontal Disk Grinder Developed by Gardner

Gardner Machine Co., 410 E. Gardner St., Beloit, Wis., has developed the No. 186 horizontal disk grinder for grinding flat surfaces of castings which do not need to have any accurately ground



surfaces relative to other surfaces. Normally supplied with a 30-in. diameter wheel, this machine is also built in the 36-in. diameter size.

Improvements over previous models include the use of V-belt drive, standard motors from 5 to 15 hp., removable guard ring and swinging bar-type dresser. With this machine either wet or dry grinding can be performed. Spindle is mounted on ball bearings completely sealed against impurities.

## "Bell-Oven" Furnace Permits Controlled-Atmosphere Heating

The demand for a small unit for heat-treating with definite atmosphere control is met by the "Bell-Oven" furnace developed by American Gas Furnace Co., Elizabeth, N. J. This furnace can be used with various atmospheres for clean hardening, carburizing, nitriding and "Ni-Carbing."

The unit comprises a conventional oven type furnace in which is provided a heat-resisting alloy bell closing down over the work during heating. This bell is quickly and easily raised and lowered by the door lifting mechanism, and does not delay or inconvenience the operator in any way. Through an opening in the top of the

*Help keep your drills*

# POINTED FOR PRODUCTION...

*... with*

## SUNOCO
EMULSIFYING
## CUTTING OIL

**PERFORMANCE DATA**
OPERATION—Drilling a 3⅛" hole in the solid.
MACHINE—"AMERICAN" 5' 15" Column Hole Wizard Radial Drill.
MATERIAL—S.A.E. 1020 Cast Steel.
SPINDLE SPEED—83 R.P.M.
FEED—.018 inch.
CUTTING LUBRICANT—1 part Sunoco to 20 parts water.
Courtesy of THE AMERICAN TOOL WORKS CO.

### SMOOTH ROUND HOLES WITH SPEED AND ACCURACY

PRODUCTION and still greater production . . . that's the order of the day. And, to meet this demand, drills must cut fast . . . cut clean . . . and hold their edges—they must *keep pointed for production!*

That's why leaders of the machine tool industry choose, use and recommend SUNOCO Emulsifying Cutting Oil for their machines. They know its high heat absorbing and lubricating qualities aid drills in cutting true cylindrical holes —with *speed* and *accuracy*. They know that—with SUNOCO—drills clear easily, do not clog, bind, chatter or burn . . . and "down time" for regrinds can be reduced.

Keep a step *ahead* of production demands with the correct cutting lubricant —use SUNOCO. Test it in your own plant—let the results prove its merits.

**SUN OIL COMPANY • PHILADELPHIA, PA.**

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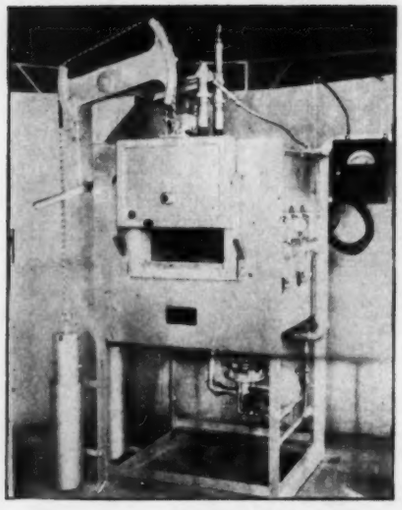
**PETROLEUM PRODUCTS FOR ALL INDUSTRIES**



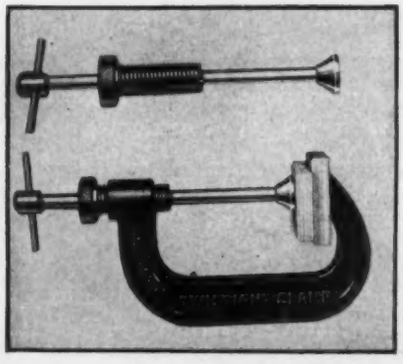
bell atmosphere gas is introduced. It escapes through a sand seal in which the bell rests and is burned in the furnace. An additional opening in the bell admits a thermocouple. Uniform heating is obtained, as the bell is entirely inclosed within the furnace and is heated by burners firing both above and below from both sides.

The bell muffle measures 11¾ in. in width, 14¾ in. in length, and 4¼ in. in height. The furnace occupies a 40x54-in. floor space and weighs 2300 lb.

## Push-Pull C-Clamp Permits Instant Operation

Claimed to be particularly adaptable to welding small assemblies in the aircraft industry, the "Twistight" push-pull C-clamp developed by Mechanics Engineering Co., Box 243, Jackson, Mich., features instant operation for maximum production.

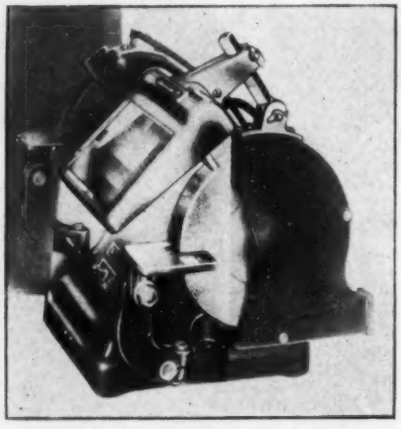
The mechanism consists of a rolling clutch inside a screw barrel, which grabs a smooth rod so that the foot f the clamp is instantly adjusted to any thickness of material. A twist to the left and a pull opens the clamp to its full capacity; a push and a turn to the right locks it; and from one-half to a full turn applies pressure. Sliding rod and swivel foot are made of Everdur, so that welding spatter will not adhere to it.



## "Flud-Lite" Eyeshields Promote Safer Grinding

"Flud-Lite" eyeshield, suitable for use on all grinders, belt or motor driven, has been developed by Stanley Electric Tool Div., New Britain, Conn. Fitted with two bayonet type light bulbs, it throws light directly on grinding wheel and work. The design and lighting arrangement provides 30 percent more visibility for the operator than previous models. The shield is adjustable up or down and can be arranged to suit the operator's position. It cannot, however, be moved to a non-guarding position without dismantling.

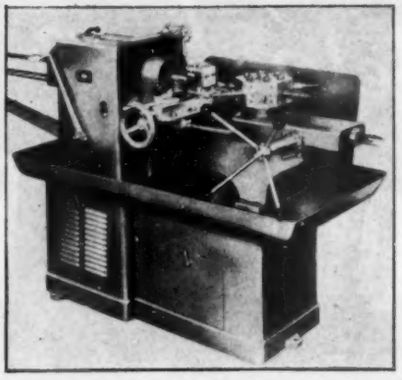
Frame is a sturdy die casting, with aluminum finish. It holds two 4x6-in. sheets of glass—one piece of safety glass, with ordinary window glass beneath, which is easily replaced if it becomes pitted by emery dust. Bulbs are made with supported filaments to withstand vibration. The shield can be set up so that lights work with grinder switch on grinders with 115 or 220 volt motors. A reflector, mounted behind light bulbs, floodlights work and wheel. The device is easy to attach.



## Oster "Rapiduction" Lathe Now Equipped With Turret

Originally equipped with a cross slide and plain saddle only, the No. 601 "Rapiduction" lathe built by Oster Mfg. Co., 2057 E. 61st Pl., Cleveland, Ohio, can now be equipped with a six-station turret. The machine thus equipped satisfies the demand for a simple, plain head, hand-operated screw machine which does not require a highly skilled operator.

The turret is hand operated and hand indexed with the saddle stops automatically synchronized with the revolution of the turret. The radial thrust of the turret is taken by a massive ball bearing, and an adjustable turret locking stud is provided for maximum rigidity. Hardened taper lock bolt and lock bolt bushings insure long wear. Each turret face has six tapped holes for mounting popular sizes of tool holders. Either a lever fed or screw fed cross slide can be furnished.



Both worm and direct drives to spindle are now available with power furnished by a two-speed motor. Reverse or electric braking control is optional. Multiple V-belts from the motor to worm shaft or spindle is the method of drive, speed changes being obtainable through quick-change sheaves giving spindle speeds from 140 to 1000 r.p.m. in the worm driven machine and from 900 to 3000 in the direct drive. The spindle and worm run on ball bearings.

## Gage Measures Sheet Steel From Only One Side

A magnetic gage which measures the thickness of sheet steel when only one side is accessible has been developed by General Electric Co., Schenectady, N. Y. The instrument is claimed to be accurate to within 0.001 in.

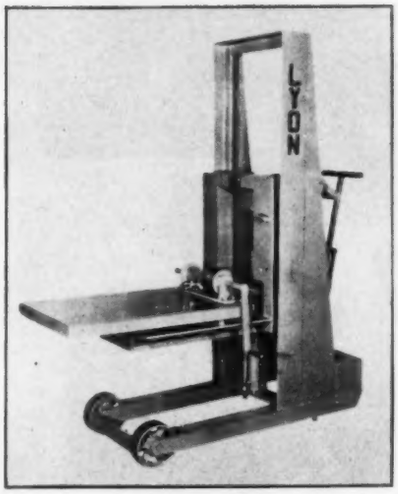
It consists of a 7-lb. portable indicating unit connected to an electric outlet, and a small cylindrical head containing an Alnico magnet. When the gage head is placed against the material to be measured, the permanent magnetic field of the head saturates the material. Quantity of magmetic flux passing through the gage head magnetic circuit depends on the thickness of the material. This thickness is indicated by the instrument reading, which is a measure of the increased reluctance of the magnetic circuit.

Thickness of any magnetic sheet or plate material may be measured by the gage as long as the material is not backed by other magnetic material. The gage is especially valuable for checking the center and other points on wide sheets of steel where use of calipers is inconvenient or impossible.

# J&L STEEL

JONES & LAUGHLIN
STEEL CORPORATION
AMERICAN IRON AND STEEL WORKS
PITTSBURGH, PENNSYLVANIA

## SPECIAL
## COLD DRAWN SHAPES
## SAVE MACHINING




## Lyon Die Handling Truck Features Revolving Table

Lyon Iron Works, 678 Madison St., Greene, N. Y., has designed a hydraulic die handling truck with revolving table arranged to revolve with stops at each 90 deg. When in its standard position, the table extends about one foot beyond the edge of the wheels so that it may be put close to the press when taking out or putting dies into the press, particularly those where the base of the press extends out beyond the bed. This arrangement is also convenient when taking dies on and off shelves where the lower shelves may have protruding dies stored on them. The table is equipped with a winch for pulling dies on and off the table.

The truck shown is of 1,000 lb. capacity and has a 24x36-in. table. Lowered height is 12 in.; elevated height is 51 in. It is equipped with a two-speed hydraulic hand pump. It can, however, be furnished with other capacities and specifications and with a motor-driven pump instead of the hand pump.

## Stanley Electric Polisher Can Be Used as Drill

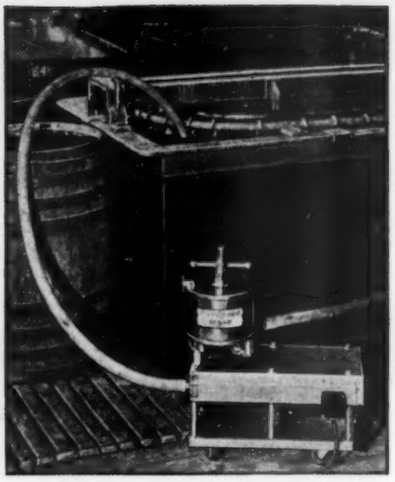
Stanley Electric Tool Div., New Britain, Conn., has developed two new polishers for cleaning and polishing metal and removing stains or heat tint caused by welding. They are slow-speed (600-r.p.m.) polishers for which special brushes and compounds have been developed for maximum efficiency. Up to four brushes can be mounted on arbors available with polishers.

No. 182 polisher, illustrated, can be used as a polisher, or a drill chuck can be attached in place of the arbors to make a ½-in. drill. Arbors for two or four brushes and ½-in. Jacobs chuck are available. No. 187 polisher has a straight handle and is used for polishing only. Arbors for two or four brushes are available. Both polishers are equipped with universal motors for 110, 125, 150, 220, 230 or 250 volts.

## Westinghouse Welding Rectifier Operates Two Machines

Designed especially for supplying d.c. power to magnetic energy-storage type spot welders such as are used for joining aluminum in the aircraft industry, an ignitron spot welding rectifier announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is available in two capacities, one for use with 40-kw., the other for 120-kw. spot welders. Each rectifier will operate two welders if they are sequenced so that only one can be loaded onto the rectifier at a time.

The rectifier consists of a control and protective panel, power transformer and ignitron power tubes all contained in a forced ventilated floor mounted sheet metal cabinet with a heavy welded base frame. Tubes are arranged for water cooling, controlled by a thermostatic flow switch. The control and protective panel is located in the top of the cabinet and the ignitron assembly in the bottom. Hinged doors provide access to the front of the cabinet, and the back is removable for maintenance. A 14-in. fan driven by a ⅛-hp. motor cools the transformer, exhausting through a grill at the rear of the cabinet.



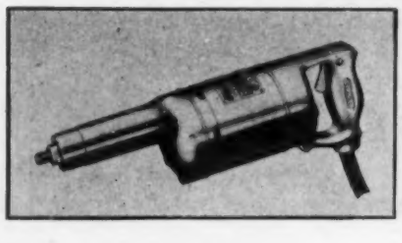
## Alsop "Hy-Speed" Filter Purifies Plating Solutions

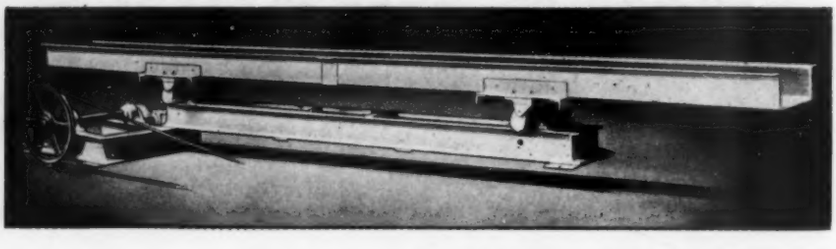
Alsop Engineering Corp., Milldale, Conn., has developed "Hy-Speed" line of filter equipment especially for keeping plating solutions clean. Using a "sealed disk" filter, this equipment eliminates problems of filter maintenance, loss of solution and necessity of a special operator.

In operation, liquid coming into the filter from a pump fills the cylinder and passes through holes provided in a series of sludge rings. The liquid is then forced through the renewable filter disks, entering a perforated screen next to them and running through channels in the screen to a common outlet in the center. Thus each disk acts as a separate filter and permits handling a large volume of solution with a relatively small unit. Special filter papers are coarse on one side and fine on the other so that filtration becomes progressively finer. The device is offered in portable pump-equipped types shown and in larger sizes for permanent installation for continuous filtering.

## "Free-Flow" Conveyor Handles Fragile Materials

A vibrating conveyor and feeder known as the "Free-Flow" has been introduced by Standard Transmission Equipment Co., 416 W. Eighth St., Los Angeles, Calif. This conveyor operates on the lift-throw principle, with the motion of the trough becoming increasingly horizontal with the progress of each cycle, thus imparting to the conveyed material a gentle, forward motion. This motion is so designed as





actually to suspend the mass in the air with only momentary contact with the trough on the upward period. This suspended float-action minimizes wear from abrasion, and the most fragile material can be conveyed without fear of breakage.

The trough is self-cleaning, without the use of chains, flights, etc. Because of this, different materials can be alternately conveyed. The oscillating arms which actuate the trough are mounted in special rubber bushings, which store the forward and return forces, thereby reducing power consumption to a minimum. Self aligning, precision ball bearings are used throughout. The trough can be of any desired material, open or inclosed for the handling of hot, gaseous or dusty materials. By means of variable-speed control of the rate of oscillation, volume can be controlled as desired. Material can be conveyed up 15-deg. inclines.

### "Mitts" Protective Cream Prevents Skin Irritation

Irritations and infections of workmen's hands from greases, paints, oils, solvents and similar fluids are prevented by "Mitts" protective cream, offered by Mitts, 367 E. 45th St., Brooklyn, N. Y. The cream is spread on the hands before starting work. It dries quickly and is not sticky. Being water soluble, it washes off easily with soap and water, taking all the dirt with it.

### Westinghouse Circuit Breaker Protects Power Supply Circuits

The Type AB-1 "De-Ion" inclosed circuit breaker developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., is intended for protection of all types of light and power circuits. This breaker is made in four frame sizes, and in ratings from 15 to 600 amp. in steps corresponding to commercial wire sizes. All are available with ratings from 250 volts a.c., 125/250 volts. d.c. to 600 volts a.c., 250 volts d.c.

Distinctive features common to all frame sizes are: silver contacts operated by a toggle mechanism to provide quick make or break action; bimetal thermal elements to prevent tripping due to harmless overloads; rust and corrosion resisting metal parts; and the "De-Ion" method of arc quenching. This feature confines, divides, and extinguishes the arc almost instantly as the contacts open, providing long contact life and reducing fire hazard.

### "Brightboy" Polishing Wheels Suitable for Stainless Steel

"Brightboy" disks and polishing wheels for removing small blemishes on finished steel have been made available by Weldon Roberts Rubber Co., 351 Sixth Ave., Newark, N. J. With these wheels marks from welds on stainless


*(advertisement)*

## Manufacturers Look to Steel Warehouses for Quick Defense Requirements

Many leading manufacturers are relying on nearby steel-service plants for prompt, stock shipment of steel to meet the current surge of business prompted by Washington's defense program.

Probably the leading exponent of "Immediate Steel" is Ryerson with a net work of ten strategically-located plants each of which has large and complete stocks of steel and allied products. In addition, each plant is equipped with complete forming and cutting facilities so steel can be prepared to customers' exact requirements. No shop should be without the Ryerson Stock List (see advertisement below).

Thousands of manufacturers report saving considerable time, trouble and money by taking advantage of Ryerson's complete flame cutting service. Modern equipment manned by specially trained operators can quickly burn any shape—no matter how intricate—from carbon or alloy steel plates and billets up to 15" thick.

"Call Ryerson"

**To be Sure of Quality Steel . . . and Fast Service, Too!**

Ryerson service to American industry combines quick shipment from vast, conveniently-located stocks *and* quality certification under which every ton of steel in this huge reserve is carefully chosen to conform to definite quality standards.

Ryerson Alloy Steels are from selected heats that meet an ideal specification—a "specification within a specification"—and are delivered to you with complete heat-treating data. No time is lost testing in your plant; spoilage is eliminated; uniform response is assured. Yet, like all other Ryerson steels, Ryerson Certified Alloys cost no more.

With steel in brisk demand, you can have a dependable source of supply, and safeguard quality, too, by ordering from the nearest of the ten Ryerson plants. If the need is urgent, we suggest you not wait for quotations but mail, phone or wire an open order. Your steel will be shipped promptly and billed at standard prices. Stock List sent on request. Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

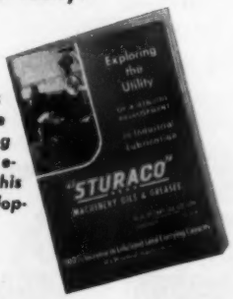
When Machine Tools CHATTER ... or Bearings and Gears run HOT— use "STURACO" EXTREME PRESSURE ("EP") MACHINERY OILS & GREASES

STICKING ways resulting from overloads means troublesome "chatter." A STURACO ("EP") LUBRICANT will often eliminate the trouble for it has a technically accepted load carrying capacity of over 300% more than ordinary lubricants.

Hot spindle bearings and gear heads can frequently be cooled to operating efficiency when the proper STURACO ("EP") LUBRICANT is applied.

Results from this unusual principle of lubrication have been astonishing. What is your tough problem? Write, wire or phone today!

SEND FOR this new 20 page booklet outlining laboratory research behind this genuine development.




• Work out your metal cutting problems with a STUART OIL Engineer. From the complete STUART line he'll help you choose the proper cutting oil to set you up for top efficiency.

Stuart Oil Products

For All Cutting Fluid Problems

D. A. STUART OIL CO. LIMITED

Chicago, U.S.A. Est. 1865

Warehouses in All Principal Metal Working Centers

steel can be quickly erased, leaving a bright, clean surface.

The wheels can be used wherever small burrs, stains, or rust appear on metal. Effective action of these wheels is claimed to result from the soft rubber binder which cushions the abrasive, thus giving a bright, lustrous finish without spoilage if the work slips during the operation.

## NEW MATERIALS

### Werner Extruded Plastic Suitable for Trim Work

"Plastikmould" and "Plastiktrim" extruded plastic shapes have been made available by R. D. Werner Co., 380 Second Ave., New York, N. Y., to take the place of many types of aluminum trim which may soon become difficult to obtain. These plastic products are manufactured in a wide range of colors in shapes and sizes similar to those now supplied in aluminum. They are also available in rods, tubes and other commercial shapes, both flexible and rigid.

### Maas & Waldstein Develop Special Plastic Finishes

Special finishes for plastics produced by Maas & Waldstein Co., 438 Riverside Ave., Newark, N. J., are said to simplify many production problems for manufacturers who may desire to turn to plastics because of metal shortages.

Use of these finishes enables manufacturers to make products of low-cost black or brown molded phenolic plastics and then finish them in any desired color and style, thus permitting standardized production without restricting the choice of finish.

Special finishes are available in all colors of both smooth and wrinkle enamels, in metallic lustres, and in hammered-metal effects. All of these finishes can be air dried or baked by either convection or radiant-heat ovens.

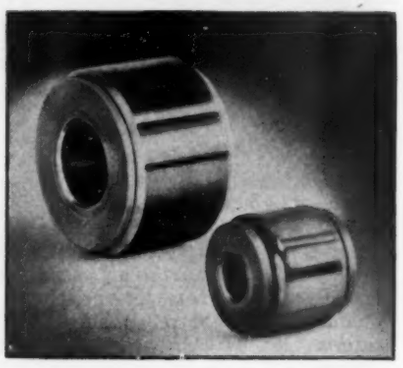
### "Non-Slip" Pulley Covering Minimizes Belt Slippage

To prevent loss of power from belt slippage, Nonslip Pulley Covering Co., Buffalo, N. Y., has developed "Nonslip Rubberpull." This product is supplied in a liquid form in convenient containers and is readily applied with a brush to the face of any pulley, flat or V-type, to prevent belt slippage.

Tests are said to demonstrate that it increases efficiency of belt drives as much as 50 per cent. The product, as its name implies, has a rubber base and is so compounded that it sticks to the pulley face regardless of the pull exerted upon it. It can be applied in a few minutes at the end of the day, and is ready for use the next morning.

### Aircraft Needle Bearings Available in Two Series

A number of needle bearing assemblies especially intended for aircraft service have been announced by Torrington Co., Torrington, Conn. The bearings



are made in two series, designated as the AR Series for normal service and the AT Series for heavy duty. Bearings in both series are provided with inner races and permanently attached end washers. All exposed surfaces are cadmium plated.

## TRADE PUBLICATIONS

**CONTROL INSTRUMENTS** Wheelco Instruments Co., 1929-33 S. Halsted St., Chicago, Ill., is circulating Bulletin No. Z4000 which provides illustrations and descriptions of remote and temperature controllers, protable potentiometers, radiation heads, thermocouples, lead wire, and flame-otrols.

**CONVEYORS AND FEEDERS** Standard Transmission Equipment Co., Los Angeles, is circulating a four-page folder which illustrates and describes free-flow vibrating conveyors and feeders. The folder contains a table which indicates capacity in cubic feet per hour.

**CUTTING TOOLS** Bulletin G-403, circulated by Fansteel Metallurgical Corp., North Chicago, Ill., provides dimensions and lists prices of solid tool bits.

**DIESEL-ELECTRIC SETS** An 18-page illustrated booklet, No. 6344, circulated by Caterpillar Tractor Co., Peoria, Ill., illustrates, provides dimensions and specifications of eight sizes of electric sets. In addition to a detailed description of the diesel engine and the self-regulating generator, the booklet contains an illustrated discussion of various installations which include machine shops, factories, and construction jobs.

**DIESEL ENGINES** Caterpillar Tractor Co., Peoria, Ill., has just published a 48-page catalog, No. 5850, in which

it presents a detailed discussion of mechanical features and manufacturing methods of its line of diesel engines. Engine parts are treated separately in the booklet, which contains many illustrations. A section of the catalog is devoted to the horsepower rating of the engine.

**DUST CONTROL** The American Foundry Equipment Co., Mishawaka, Ind., has published a 12-page booklet which describes the operation and construction of dust collecting equipment.

**ENGINEERING DEVELOPMENTS** Allis-Chalmers Mfg. Co., Milwaukee, has issued "The 1940 Annual Review", a 100-page booklet with 240 illustrations which provides a complete picture of Allis-Chalmers' cooperation with industry, agriculture and the national defense program.

**GEARS** Atlantic Gear Works, 200 Lafayette St., New York, N. Y., has just issued its 1941 general catalog on stock gears, sprockets and chains, reducers, bearings and couplings. Full specifications and prices are included.

**HANDLING EQUIPMENT** Material handling equipment is illustrated and described in Circular No. 120 circulated by Lyon Iron Works, Greene, N. Y. The equipment, most of which is hydraulic, includes lift trucks, cantilever elevating tables, die handling trucks and sheet handling trucks.

**HOISTS** Gar Wood Industries, Inc., Detroit, has issued Bulletin No. 2 which illustrates and describes a complete line of cam and roller hoists for installation on all sizes of trucks, trailers, and six-wheelers. Another Bulletin, No. 11, also circulated by the company, illustrates and describes hydraulic repair towers for installation on any truck chassis rated 1½ tons or more.

**MOTORS** Leaflet No. 3706.1, circulated by Westinghouse Electric & Mfg. Co., describes fan-cooled explosion resisting motors.

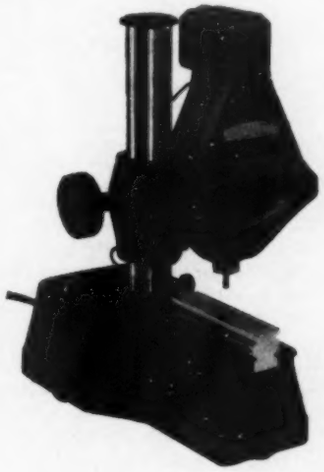
**PRECISION INSTRUMENT** Caterpillar Tractor Co., Peoria, Ill., has issued a 40-page booklet, No. 6231, describing precision manufacturing methods, and includes work to within a few millionths of an inch. The machines and gages necessary for this kind of production are discussed and photographed.

**SELECTORS**—Ampco Metal, Inc., Milwaukee, is distributing a slide selector by which physical properties and composition of metals may be ascertained.

**SHOVELS AND CRANES** A 16-page illustrated Catalog, No. 1885, circulated by Link-Belt Speeder Corp., Chicago, illustrates and describes its Speed-o-Matic Series "500" shovels, draglines and cranes. Emphasized

The attention of industry is being called emphatically to the urgent need for accurate and rapid inspection at tolerances never before encountered in a period of rapidly expanding production.

In order to handle this tremendous volume of gaging operations with the highest degree of precision, gages such as the Sheffield Visual Gage are absolutely essential. The Visual Gage is highly sensitive, instantaneous in its action and deadly accurate (checking to thousandths, "tenths" and millionths of an inch). It is used for checking dimensions of manufactured and purchased parts, tools, production and master gages.



At the same time it is very simple in construction, can be handled easily by anyone familiar with inspection work, and is extremely durable.

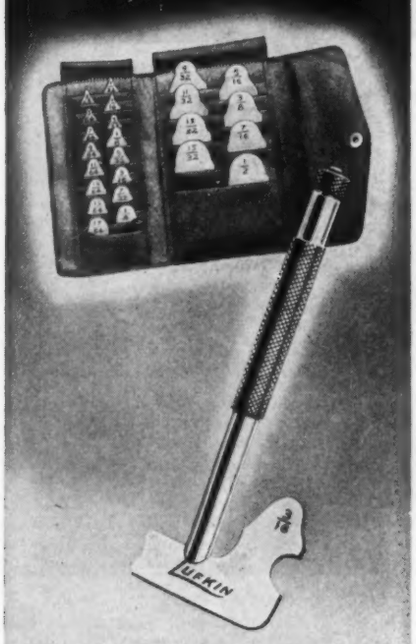
The Reed Mechanism (the heart of the Visual Gage) is positive in action and entirely free from the limitations of frictional wear. It contains no gears, knife edges or rubbing contacts—nothing to wear out of adjustment. Measurements by the Visual Gage are always consistent and thoroughly reliable. It is one of the most efficient instruments available to inspection.

*Write for details*

SHEFFIELD
GAGE CORPORATION • DAYTON, OHIO, U.S.A.
MASTER GAGEMAKERS

LUFKIN

RADIUS GAGES




EASY TO USE
5 APPLICATIONS

Because each blade in the Lufkin set of Radius Gages is a separate unit, it is more easily and accurately applied to the work. No other parts of the set can cause interference. Each blade has five applications for its individual radius and carries the corresponding external and internal forms. An attractive, durable leatherette folder is supplied with each set to not only protect the gages, but to make the selection of them simple and easy. And for hard-to-get-at places, use the Lufkin Gage Holder which is furnished at a slight additional cost.

BUY THROUGH YOUR DISTRIBUTOR

LUFKIN

SAGINAW, MICHIGAN · New York City

TAPES · RULES · PRECISION TOOLS

features in the description are: Welded unit construction; interchangeable crawler side frames; self-guiding treads, self-aligning rotating rollers and center pin bearing; high ground-clearance; ease and speed of handling. Dimensions, clearance diagrams, working ranges, lifting capacities are among other features which are described.

**SLING CHAINS** A new edition of a catalog on sling chains is being circulated by American Chain Division, American Chain & Cable Co., Inc., York, Pa. The book provides complete specifications and covers chain made from different analyses of steel as well as from iron.

**SPEED REDUCERS** Winfield H. Smith, Inc., Springville, N. Y., has published a four-page folder which illustrates, describes and provides specifications of differential speed reducers.

**STANDARDS FOR 1941** The American Standards Association has published a new list of American Standards for 1941. More than 400 standards are listed, covering definitions, technical terms, specifications for metals and other materials, methods of test for the finished product, dimensions, safety provisions for use of machinery, and methods of work. Copies of the list may be secured by writing to American Standards Association, 29 West 39th St., New York, N. Y.

**SWITCHES** Micro Switch Corp., Freeport, Ill., has published a 2-page folder which provides descriptions, prices and illustrations of a complete line of micro switches.

**SWITCHES** Leaflet No. 15-075, circulated by Westinghouse Electric & Mfg. Co., describes planer limit switches for the machine tool industry. Application and construction of the 2, 4, and 6 pole switches are discussed.

**SWITCHES** Micro Switch Corp., Freeport, Ill., has issued a 36-page illustrated catalog, No. 52-1, which presents complete engineering data on precision snap-action switches, including dimensions, prices, operating characteristics, and information as to their application.

**STARTERS** A 4-page circular, No. 330 published by the Trumbull Electric Mfg. Co., Plainville, Conn., illustrates and describes a new line of combination magnetic starters.

**SWITCHGEARS** A 15-page bulletin, No. 32-160, circulated by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., describes and illustrates heavy duty metal-clad switchgears for use in steel mills and industrial plants. Both indoor and outdoor types are completely described, attention being given to housing, control devices, elevating mechanism and oil circuit breakers..

**TRANSMISSIONS** Western Mfg. Co., Detroit, is circulating a 4-page catalog which illustrates and describes transmissions for motorizing various cone driven machine tools.

**VALVES R-S** Products Corp., Philadelphia, Pa., has issued a new 12-page bulletin, No. 8-B, which features late models of standard and wafer type butterfly or blast gate valves for the control of air, gas, steam and liquids.

**VALVES** An 8-page bulletin, No. 4-4500-D, circulated by Hancock Valve Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn., illustrates and describes super finished bronze valves. Specifications and working pressure ratings are also provided.

**VOLTAGE REGULATOR** A new 19-page bulletin describing voltage regulators for a-c and d-c generators is being circulated by Westinghouse Electric & Mfg. Co. The operating details of each regulator type are presented with diagrams showing construction and wiring.

## NEW BOOKS

JOB EVALUATION AND MERIT RATING—*By Eugene J. Benge, management engineer. 136 pages. Published by the National Foremen's Institute, Inc., Deep River, Conn. $7.50.*

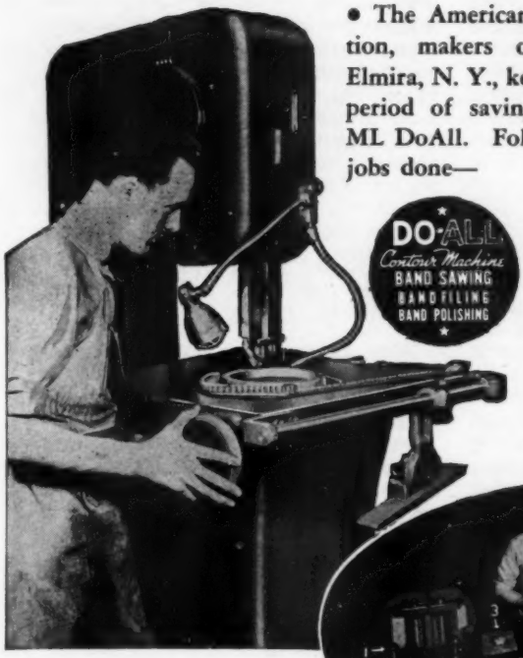
Until the time of Frederick W. Taylor, wages were determined either by fiat or by bargaining. Taylor's system of scientific management introduced the principle of determining wages by analysis of the work to be performed. Principally this analysis consisted of listing the steps needed to perform a given job, and the time necessary for each step, in order to accumulate a standard time for the production of a single unit. From this beginning have sprung the many wage incentive plans in use today.

However, there are many tasks where it is impractical or too expensive to use a stop watch. Whether or not time standards have been established, there still remains the problem of establishing either the base rate or the probable average over-all earnings of employees on various grades of work.

All systems for establishing wage rates by job evaluation are relative. The first duty of a management that is attempting to set up a fair and defensible schedule of rates is to make certain that the relative standing of all jobs is correctly determined, the second duty is to price each job on an equitable base.

Job evaluation is primarily concerned with the elimination of inequalities in the wage structure. It also can be the foundation of a wage administration plan which will, in itself, point out to employees how they can obtain larger incomes by proving ability to handle

# DoALL saves $500 *in three weeks*




• The American LaFrance Foamite Corporation, makers of fire fighting equipment, Elmira, N. Y., kept a record during a 3-weeks' period of savings effected with one Model ML DoAll. Following are only a few of the jobs done—

| | Old Method | On DoAll |
|---|---|---|
| 1 | 15 hours | 5½ hours |
| 2 | 2½ hrs. each | ¼ hour each |
| 3 | 5 hours | 1½ hours |
| 4 | 15 hours | 2 hours 3 min. |
| 5 | 9 hours | 2 hours |
| 6 | 5 hours | ¼ hour |
| 7 | 12 hours | 2 hours |
| 8 | 12 hours | 3 hours |
| 9 | 1 hour each | ¼ hour each |
| 10 | 2 hours | ¼ hour |

*America's*

## GREAT DEFENSE TOOL

The DoAll is the indispensable modern machine tool for speedy, accurate performance in handling scores of metal working jobs, formerly done on the shaper, lathe and milling machine. Now used in large and small plants everywhere to effect short cuts in making molds and dies, special tools and parts in the manufacture of armaments, motorized equipment, aeroplanes, battleship parts, etc.

**DoAll Grinder**

A super precision surface grinder — a real production tool. Less vibration because motor is built right on ball-bearing spindle. Work table has exceptionally large bearing surface. Hydraulic table travel is infinitely variable, up to 50 f.p.m.

**Band Filer**

Does faster, better, smoother continuous filing on all materials from high-carbon steel to brass, wood, etc. Your choice of 21 styles of file bands, ½", ⅜" and ¼" wide, flat, oval or half round.

Let us send a factory trained man to your plant to show you what a DoAll can do and save for you.

•

**FREE** — Literature and Handbook on Contour Machining, 158 pages of valuable metal working helps.

**CONTINENTAL MACHINES, INC.**

**1310 S. Washington Ave.** **Minneapolis, Minn.**


a better job. Merit rating permits the appraisal of individual effort of workers where definite measurement is impracticable. It attempts to qualify and quantify the judgment of a superior as to the worth of individual subordinates. The author has given over a large part of this volume to a discussion of various orthodox rating methods and has given a number of rating cards and charts as examples of how these methods are used in practice.

•

CHAMBER'S TECHNICAL DICTIONARY—*edited by C. F. Tweney, editor of "A Technological and Scientific Dictionary," and L. E. C. Hughes, Imperial College of Science and Technology, London. 557 pages. Published by The Macmillan Company, 60 Fifth Ave., New York. $5.00.*

So great has been the growth of scientific and technical terms that today they create a language in themselves. It is fitting, therefore, that they should have a dictionary of their own. Chamber's Technical Dictionary is designed to fill that need. This volume includes terms commonly used in the mechanical trades, but also covers the fields of pure and applied science, medicine, engineering, construction, and the manufacturing industries.

While useful to the specialist, this dictionary is written in language understandable to the technically minded layman and to students. It includes thousands of words not used in daily speech, but in addition fully defines many common words having special significance as technical terms.

So far as make-up is concerned, this volume follows standard practice giving correct pronunciation and abbreviations and having an appendix which includes a bibliography and a number of technical tables of basic importance.

•

HOW TO SUPERVISE PEOPLE—*By Alfred M. Cooper, consultant. 150 pages. McGraw-Hill Book Co., 330 W. 42 St., New York, N. Y. $1.75.*

A concise, practical manual explaining how foremen may analyze their jobs and apply correct methods of handling supervisory problems, this book covers all the typical jobs of hiring, reprimanding, firing; getting cooperation, delegating authority and training workers. Included are specific solutions which many supervisors in conference testify are those that get best results.

The volume is intended to be used as a reference book by supervisors, as a textbook for beginners in supervision, and (with the aid of discussion questions appended to the subject matter) as a supplementary text for foremanship, supervisory and executive training conference discussion groups. Toward this end both a well-organized presentation of the subject and an ex-

WITH THESE

**FITCHBURG GEAR GRINDERS**

**New Operators**

***can speed output and boost profits for you***

UTILIZING the formed wheel method with automatic closed cycle, new operators can be quickly trained to produce accurate work with fine finish at higher speeds on these machines.

Electric counter control makes overrunning unnecessary on most work, but extreme accuracy is easily obtained by a final truing followed by a light cut taken on a single operating cycle.

Accurate truing is simplified by 6 to 1 ratio of former size to grinding wheel size, which minimizes errors.

*New free booklet profusely illustrated gives full information on this profit producing equipment. Write for it today.*

**FITCHBURG**
**GRINDING MACHINE CORP.**
**1704 FALULAH ROAD**
**FITCHBURG, MASS., U. S. A.**


tensive index contribute considerable.

Though any book of this nature is bound to include a few platitudes, in this work they have been held to an absolute minimum, the author preferring concrete suggestions. Indeed, the down-to-earth, realistic approach to the shop supervisors' problems should prove a welcome relief from the mass of nonsense currently being gushed on the subject of handling people. For the successful supervisor, the serious student and the ambitious apprentice this book should do much to remove many stumbling blocks.

•

MECHANICAL WORLD YEAR BOOK, *1941 Edition—268 pages. Emmott & Co., Ltd., 31 King St. West, Manchester 3, England. Two shillings.*

As with the previous edition, selection of material for this edition has been guided largely by wartime needs. Completely new sets of tables for all the more familiar ball and roller bearings are included. New formulas permit quick determination of the bearing required for definite service conditions and for any speed instead of a restricted number of speeds as usually given in load tables.

New matter is also provided on various case-hardening processes. Tabular matter (complete with a separate index) is continued. The text generally has received numerous revisions to keep it up to date.

•

BOLTS, NUTS & SCREWS—*Compiled by A. E. R. Peterka, technical assistant to the vice-president, The Lamson & Sessions Company. 70 pages. Published by The Lamson & Sessions Company, Cleveland, Ohio. $1.00.*

Comprising reprints of articles dealing with the subject of nuts, bolts and screws, this volume presents information of interest to those engaged in making, selling and using all types of threaded parts. Design, manufacturing and research data accumulated over the past few years and published in most of the leading metal-working journals are included. Particular emphasis on various methods of manufacture and recent research findings characterize the work.

•

THE ELECTRICAL YEAR BOOK *1941 Edition —374 pages. Emmott & Co., Ltd., 31 King St. West, Manchester 3, England. Two shillings.*

A collection of electrical engineering notes, rules, tables and data, this volume includes among its new material an explanation of the superimposed "ripple" for use with a.c. circuits for remote control. In the section on rectifiers, details have been added on the pumpless air-cooled steel-clad type. Various regulations of the provisions for electrical equipment of buildings (I.E.E. wiring regulations) are reviewed in detail in a new section. Another new section deals with localization of cable faults and describes various tests used in present-day practice.

The subject of testing has received further attention in that the section on testing sets has been overhauled, much of the matter rewritten and new information included. Some tables have been extended and others of a generally useful kind added. Detailed revision has also been made in other parts to keep the text generally in line with current practice and requirements.

•

TRADE NAMES INDEX—*178 pages. Published by Special Libraries Association, 31 E. Tenth St., New York. $4.00.*

Who makes the "Gimmick" tool grinder? Such a question is likely to come into one's mind when he needs such equipment, but the answer is not always easy to find. Trade names have a way of being elusive. Often they have little or no connection to the material or equipment which they describe, and little hookup to the name of the manufacturer.

Other publications have attempted to list trade names for a particular field or a particular product, but this volume seems to be the only one devoted exclusively to this purpose. It lists the names alphabetically and describes them briefly, dictionary style, giving the name of the manufacturer. References to other publications which contain a more detailed description of the product are also included.

The only trouble with trade names is that they refuse to remain static for long. Old ones fade out of the picture, and new ones are coined daily. Therefore, a volume like this will be subject to periodic revision.

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## Arc Welding Memos

A good welder never forgets certain simple rules which help to produce the best work and to insure the safety of his fellow workers.

1. Remember to put up a screen when welding near other workers so that their eyes will be protected.
2. Remember the danger of the light rays from the welding arc, don't look at the arc with uncovered eyes and keep behind the welding screen.
3. Remember to properly protect your eyes, your face and neck and to provide protection for the body and for your clothing from sparks and molten particles.
4. Remember to use something to protect your eyes from flying particles of scale when hammering or cleaning a weld.
5. Remember that it is sometimes dangerous and often upleasant to re-

ceive a slight shock which may be caused from the current passing to the earth through the body, therefore, don't weld while standing on a wet or damp floor.

6. Remember to break the arc as quickly as possible when finishing an electrode or a line of welding. Increasing the gap or length of arc generally means burning the metal and leaving cavities in the seam.

7. Remember to grip the holder steadily without tensing the muscles. Gripping an electrode holder too tightly causes unsteadiness of the arc because of tension in the muscles.

8. Remember that an unsteady arc can be caused by swinging of the cable. Don't allow too much cable to dangle from the holders.

9. Unless absolutely necessary don't weld in an uncomfortable position. A more accurate adjustment of the arc can be maintained and work can be carried out more efficiently when comfortably seated.

10. Remember that the work must not become loose from the ground connection. This will create a series of small arcs as the material is moved around and cause discoloration of the surface.

11. Remember that if the electrode remains shorted to the work for any period to time the rod will heat and the properties of the coating will be destroyed. If the coating on the rod has been heated up it is better to discard the rod because of the possible deterioration.

12. Remember that an oily surface sets up resistance to the formation of the arc and at the same time repels deposition of the metal. Be sure that the surface has been thoroughly washed or cleaned in a degreaser.

13. Remember that the coating on electrodes will usually absorb moisture causing them to deteriorate, therefore never store them in a damp place.

---

## What Would Happen If . . ?

What would happen if only *some* labor-saving machinery were abolished?

Come with me through the Caterpillar Tractor Company factory. Assume we have been directed to produce the same quality and same number of machines as at present, but on certain jobs do away with mechanization. Not entirely, but simply to the point where more men could be employed at productive jobs.

As you go through our factory you see many men using small electric or air hoists to lift parts onto or from machines. You also see gas-electric trucks carrying semi-finished and finished parts about the plant. You may see a tractor hauling a long train of small steel cars. It would be physically possible to do this lifting of small parts by hand joists, and we could convey the product through the plant with hand vehicles. We could do this and still build as good a product as we now produce.

But let us see what would be the result. We have carefully estimated the amount of work done by these hoists and trucks and find that to do minor lifting and to transport material, there is each day consumed a total of 8,900 hp.-hr. of energy.

A man can develop about 1/10 hp. Thus a man would in an 8-hr. day develop a little less than 1 hp.-hr. It would appear, therefore, that these hoists and trucks took the place of 8,900 men. But the men now operating mechanical hoists and trucks, by working harder could themselves do a certain amount of work. We will assume they would do about one-third of this work, making it necessary to add about 5,000 men to do the rest. The first observation might be a great sense of gratification over this employment of 5,000 more men. However, this heavy lifting and carrying would involve greatly increased physical hazards to all concerned.

But let us look still further. People who buy our products are free to select whatever make they choose. The primary reason they employ our machinery is to do a job at lower cost. The price they pay for machines is a very considerable factor in their choice of using machines built at Caterpillar, using machines built elsewhere, or using machines at all.

If we were to pay those 5,000 extra men just what it cost to employ mechanical units, they would earn about ten cents a day, because that is, if anything, a high figure for the cost per hp.-hr. of the energy used in our hoists and trucks. In this day and age no manufacturer could pay such a small wage—in fact, it is unlawful.

People who demand that hand labor replace machinery in every case assume that the worker will be given what is considered to be a living wage. Let us assume, therefore, that the men in this plant will be paid our minimum hourly wage, which would return to them an annual income of about $1300. Thus 5,000 men at $1300 a year means $6,500,000 must be added to our costs without increasing the volume or quality of our product. Taken over a period of years, this is more than our earnings—more than our dividends.

What to do? The selling price of our product would have to be greatly increased. The net result would be a material reduction in sales, a reduction of all types of employees, to the end that many less than our present number of employees would find work here. When more hours of work are devoted to producing the same amount of any product, the price to the buyer—either in dollars or in terms of hours of his labor—*must* go up. Thus we spend more and more time producing less and less, until we have turned the clock back to complete hand economy and scarcity.

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*Abstracted from a talk by L. J. Fletcher, assistant general sales manager of Caterpillar Tractor Company.*


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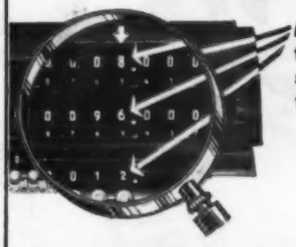

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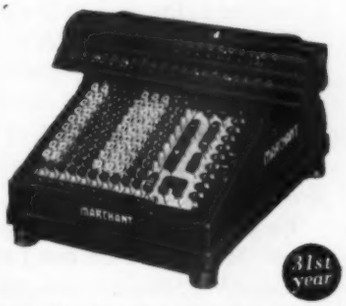


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